This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

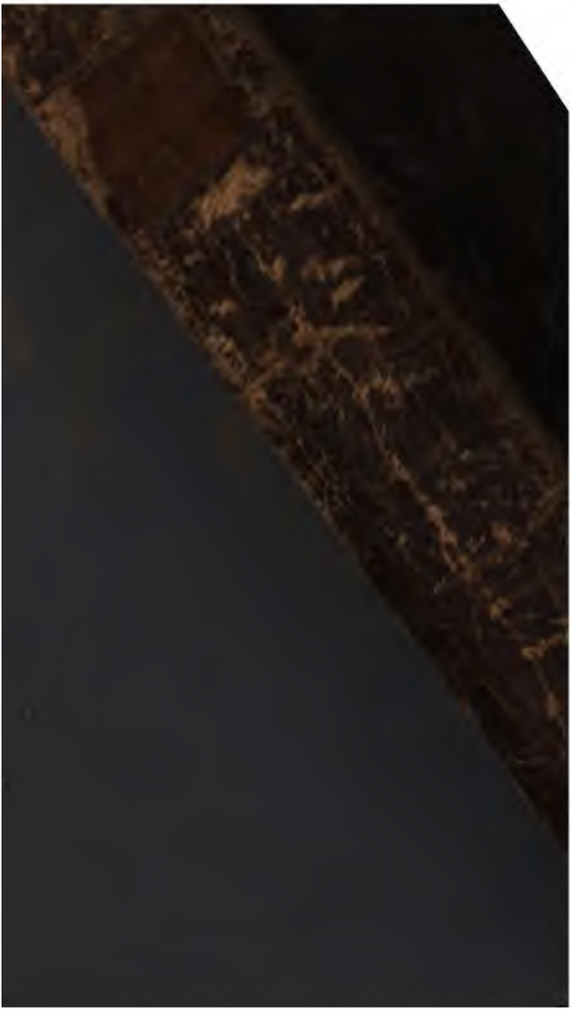
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`



118
12.880

T 118.12.880

Harvard College
Library

By Exchange

3 2044 096 989 645

Charles Collins
his property Baugh
at pittsburgh new
prise 75 cents
Steal not this book fa
fear of Shame for hea
you se the owners nam

Charles
Charles

26
36
38
5
1
5 - 7 5
1 5
21

THE

American Arithmetic,

ADAPTED TO THE

CURRENCY OF THE UNITED STATES.

TO WHICH IS ADDED

A CONCISE TREATISE ON THE

MENSURATION OF PLANES AND SOLIDS.

COMPILED FOR THE USE OF SCHOOLS, &c.

BY OLIVER WELCH.

EXETER:
Printed by C. Norris & Co. and sold at their Bookstore;
sold also by E. Little & Co. *Newburyport*, and by
the principal Booksellers in *New-England*.

1812.

Educ T 118.12.880

HARVARD COLLEGE LIBRARY
BY EXCHANGE

FEB 23 1942

NEWHAMPSHIRE DISTRICT, to wit:

BE IT REMEMBERED that on this thirteenth day of July, in the thirty seventh year of the Independence of the United States of America, OLIVER WELCH, of Exeter, in said district, hath deposited in this office the title of a book, whereof he claims the right as Author, in the following words, to wit...."THE AMERICAN ARITHMETIC, adapted to the currency of the United States, to which is "added, a concise treatise on the Mensuration of Planes and Solids, "Compiled for the use of schools, by OLIVER WELCH." In conformity to the Act of the Congress of the United States, entitled "An Act for the encouragement of learning, by securing copies of Maps, Charts and other books, to the Authors and Proprietors therein mentioned—And also "An Act for the encouragement of learning, by securing copies of Maps, Charts and other books, to the Authors and Proprietors therein mentioned, and extending the benefit thereof to the arts of Designing, Engraving and Etching historical and other prints.

R. CUTTS SHANNON,
Clerk of New-Hampshire District.

A true copy of Record.
Attest....R. CUTTS SHANNON, Clerk.

PREFACE.

MY principal design in publishing this book is to furnish Schools and Private Individuals with a concise system of Arithmetic, written in dollars and cents, connected with a treatise on Mensuration of Planes and Solids.

The Arithmetical part I have made as concise as possible, have explained the rules in a very familiar manner, and have made such arrangement of them, as I have found by an experience of thirteen years, to be most likely to forward the learner; I have omitted many rules which are found in other books of this kind, that I might have more room to treat on Mensuration; on which, I have written as largely as the intended size of the book would permit. I trust that the candid reader will find the rules inserted in this book, which are not found in other arithmetics, to be much more necessary for the young learner to be acquainted with, than those which I have excluded.

"One of the eastern Sages being asked what was most necessary for boys to learn; answered, what they ought to practice when they become men." Feeling desirous to promote the good of the Publick, by facilitating the education of youth, I have endeavoured to treat of nothing in this book, except what is really necessary for every young person to become acquainted with. I have treated of the method of making taxes, as is generally practised in the state of New Hampshire; and have added many other new problems in different parts of the work which will be useful and entertaining. I have spent much time, and been at no inconsiderable expense to render this book valuable to the risen, and rising generation; I sincerely hope that it may prove useful to the publick, and be worthy of their approbation and support. It has been fashionable in the publication of books of this kind, to introduce them into publick notice, through the influence of recommendations: but I think if a book has merits of its own, it will recommend itself; and if it has not merits of its own, it will not be supported even if others have recommended it. I have been at considerable trouble to have the copy carefully examined by the Instructers of Schools, who highly approved of the work, and gave me liberty to make use of their names as recommenders; but having a desire that it might rise into notice by its own intrinsic value, I have submitted it to the publick without any other support than its own merits.

THE AUTHOR.

Exeter, (N. H.) July 8, 1812.

THE

AMERICAN ARITHMETIC,

AND

PRACTICAL MENSURATOR.

ARITHMETIC is the art of computing by numbers; these numbers are called Figures, *viz.* 0, 1, 2, 3, 4, 5, 6, 7, 8, 9,—0, of itself has no value, but when joined to the right of other numbers, it increases their value in a tenfold proportion. Thus, 1 is one, 10 is ten, 2 is two, 20 is twenty.

Of other Characters used in Arithmetic.

$+$ Is the sign of Addition; and shews, that the number which follows the sign, must be added to the number before it. Thus $9+10$ signifies that 9 and 10 are to be added.

$-$ Is the sign of Subtraction; and denotes the number following it, must be subtracted from the one before it. Thus, $16-4$ signifies that 4 must be taken from 16.

$\times$ Is the sign of Multiplication; and denotes that all the numbers, between which it is placed, are to be multiplied together. Thus, 9×9 signifies that 9 is to be multiplied by 9, or $9\times9\times9$ must be multiplied.

$\div$ Is the sign of Division; and denotes the number standing before it, is to be divided by the number following it. Thus, $9\div3$ signifies that 9 is to be divided by 3.

$=$ This is the sign of equality; and signifies the sum or product of the numbers before it, is equal to the number after it, $2+4+5=11$ mean that 2, 4 and 5 added, their sum would be 11; and $2\times4\times5=40$ mean, that 2 and 4 multiplied, and that product multiplied again by 5 the product is equal to 40; and also 9 × 8 ÷ 12 = 6, means that 9 and 8 multiplied, and the product divided by 12, the quotient will be equal to 6.

: :: : Are the signs of proportion; and are as 7 : 14 :: 8 : 16, and are read as 7 to 14, so is 8 to 16.

$\sqrt{}^2$ This shews the Square Root of the number is required.

$\sqrt{}^3$ This shews the Cube Root of the number is required.

NUMERATION TABLE.

Millions of Millions.	Hundreds of Thousands of Millions.	Tens of Thousands of Millions.	Thousands of Millions.	Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.
1	2	3	4	5	6	7	8	9	4	3	2	3
	2	3	4	5	6	7	8	9	4	3	2	3
		3	4	5	6	7	8	9	4	3	2	3
			4	5	6	7	8	9	4	3	2	3
				5	6	7	8	9	4	3	2	3
					6	7	8	9	4	3	2	3
						7	8	9	4	3	2	3
							8	9	4	3	2	3
								9	4	3	2	3
									4	3	2	3
										3	2	3
											2	3
												3

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1
2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	2
3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	3
4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	4
5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	5
6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	6
7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	7
8	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	8
9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	9
10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	10

The use of this Table in Addition.

Look for the number to be added on the left or right hand, and the number with which you would add it on the top, and in the corner, or angle in which the lines meet, stands the sum required.—It is required to add 7 with 13, look for 7 on the left, or right, and move along on that line till 13 on the top stands directly over, and in the angle of the two lines stands 20, the sum required.

The use of this Table in Subtraction.

Look for the number to be subtracted on the left or right hand column, and on that line look along towards the right or left hand, till you find the number from which you would subtract, and directly over that number on the top, is a number answering to the remainder.

EXAMPLE.

Required to take 9 from 15, look for 9 on the left or right hand, then follow that line towards the right or left till you find 15, and on the top directly over 15 is 6, the remainder required.

* * *

SIMPLE ADDITION.

Simple Addition teaches to add together several sums of the same denomination.

Rule. Set down units under units, tens under tens, and hundreds under hundreds, &c. Begin to add in the place of units, add all in that column, carry one for every ten that is in the sum of units, to the place of tens, and set down all that is over ten, or tens; add up the column of tens, carry one for every ten to the next column, and set down all that is over, thus proceed through all the columns to the last; and in the last column observe to set down the whole sum.

Proof.—Begin at the top add downwards, carry as before, and if the work is right, the sum will be the same as it was when added upwards.

Examples.

123456	34564	98764321	64321
654321	32567	12345678	4321
123456	37432	82456781	5432
654321	12345	94321452	432
1555554	116908	287888232	74506

1. Add together 345674, 98736, 456752 and 7654.
Ans. 908816.

2. Add 94321, 675431, 1234 and 76432 together.
Ans. 847418.

3. Add 6421, 94742, 6752 and 875432 together.
Ans. 983347

4. Add 67432, 98891, 65641 and 77421 together.
Ans. 309385.

5. Add 9944, 2343, 78764 and 94929 together.
Ans. 185980

6. I lent a friend 942 dollars, at one time, at another 741, at another 91; what is the whole sum lent?
Ans. 1774 dolls.

7. A man killed 4 hogs, weighing as follows; one 396, one 472, one 510 and one 371; what did they all weigh?
Ans. 1749.

8. I killed an ox, his quarters weighed 642, his hide 105, his tallow 92; what did they all weigh? Ans. 839.

9. A man gave to three sons as follows, to one 3427 dolls. to another 3025 dolls. to another 2947 dolls.; what did he give to all of them? Ans. 9399.

10. A man's taxes were as follows for 3 years; the first 142 dolls. second 165, the third 210 dolls.; what did he pay in three years? Ans. 517.

SIMPLE SUBTRACTION.

Simple Subtraction teaches to take a less number from a greater, that is of the same denomination.

RULE. Write the largest number down first: and the smallest underneath, units under units, &c. begin to subtract in the place of units; and take the under from the upper figure; set down the remainder: If at any time any particular figure in the lower line is larger than the one immediately over it, subtract the under figure from ten; to the remainder add the upper figure and set it down; and carry one to the next figure in the lower line; thus proceed through the whole.

Examples.

From	245678	456789	784567	943213456
Take	136789	217894	659432	744321234
Rem.	108889	238895	125135	198892222

N. B. To prove Subtraction whether it is Simple or Compound, add the remainder and lower line together and the sum will be like the upper line if it is right.

Questions in Subtraction.

1. What is the difference between 24567 and 7456? Ans. 17111.

2. I lent a friend 2456 dolls. and received in part 1342 dollars; what remains due? Ans. 1114 dolls.

3. A merchant owes 34323 dolls. his effects are worth but 22749 dollars; how much will he fall in debt? Ans. 11574 dolls.

4. A merchant has an estate in his hands valued at 52394 dols. he owes 31399 dolls; what is he worth after paying his debts? Ans. 20995 dolls.

* * *

SIMPLE MULTIPLICATION.

Simple Multiplication is a compendious way of adding; as 9 multiplied by 6 is equal to 54, and is the same as if 9 were set down 6 times and added up.

The number given to be multiplied is called the multiplicand.

The number given to multiply by, is called the multiplier.

The number arising from the operation is called the product.

The following table must be committed to memory [illegible] fore any progress can be made in Multiplication.

Multiplication Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

CASE I.

When the multiplier is a single figure.

Rule. Under the multiplicand write down the multiplier, in the place of units; draw a line and multiply every figure of the multiplicand, by the multiplier; observing to carry one for every ten to the next product.

N. B. The whole product of the last figure multiplied, must be set down.

Examples.

234	345	942	674	541	742	812	899
2	3	4	5	6	7	8	9
468	1035	3768	3370	3246	5194	6496	8091

N. B. Simple Multiplication may be proved best by Sim- [illegible] Division; but as the learner has not, as yet, obtained to [illegible] knowledge of Division, I shall show the method of proving it by casting away the nines. **Rule.** Make a cross thus $\overset{0}{\underset{0}{2 \times 0}}$

Example.

To prove the first question. I cast the nines first from the multiplicand and there remains 0, which I place at the right of the cross. I then cast the nines from the multiplier, and there remains 2, which, I place at the left of the cross; I then cast the nines from the product, and there remains 0, which I place at the top. I then multiply the right and left figures together, and cast the nines from the product, and there remains 0; which I place at the bottom of the cross; And the top and bottom figures are alike, as they always must be if the work is right. This rule is however liable to an error; for if any of the figures happen to be transposed, as if, 468 in the product should happen to be written 648 the work would prove, and an error would still exist.

CASE II.

When the multiplier consists of several figures.

Rule. Set down the multiplier under the multiplicand, units under units, &c. multiply each figure in the multiplier into every figure in the multiplicand, singly, as in case first, observing to set down the first figure of the product exactly under the figure by which you are multiplying; then add the several products together, their sum will be the product required.

Examples.

	Proof.		*Proof.*		*Proof.*		*Proof.*
234	$\overset{0}{\underset{0}{5 \times 0}}$	645	$\overset{6}{\underset{6}{1 \times 6}}$	121	$\overset{3}{\underset{3}{3 \times 4}}$	763	$\overset{4}{\underset{4}{7 \times 7}}$
23		19		21		52	
702		5805		121		1526	
468		645		242		3815	
5382		12255		2541		39676	

Questions.

	Multiplicands.			*Multipliers.*		*Products.*
1st.	24567	×	by	123	=	3021741.
2d.	12434	×	by	432	=	5371488.
3d.	12345	×	by	246	=	3036870.
4th.	45678	×	by	333	=	15210774.
5th.	23243	×	by	2002	=	46532486.
6th.	34567	×	by	4001	=	138302567.
7th.	23456	×	by	1003	=	23526368.
8th.	90042	×	by	9009	=	811188378.
9th.	701231	×	by	1231	=	863215361.

CASE III.

When there are cyphers on the right hand of the multiplicand, or multiplier, or both.

RULE. Multiply by the figures only: and to the right of the product annex as many cyphers, as are equal to the number of cyphers in both factors.

	101200	456000	94000
	200	3000	20
Products.	20240000	1368000000	1880000

Questions.

	Multiplicands.			*Multipliers.*		*Products.*
1st.	621000	×	by	2900	=	1800900000.
2d.	700000	×	by	9900	=	6930000000.
3d.	854000	×	by	7600	=	6490400000.
4th.	943200	×	by	7000	=	6602400000.
5th.	94944	×	by	600	=	56966400.
6th.	412342	×	by	550	=	226788100.
7th.	671230	×	by	123	=	82561290.
8th.	421233	×	by	120	=	50547960.
9th.	4567852	×	by	9000	=	41110668000.

Practical Questions.

1st. A man had a farm on which he raised 360 bushels of wheat; and he had another, on which he raised 6 times as much; what quantity did he raise on both of them?
Ans. 2520 bushels.

2d. A man had an estate which he divided among 9 sons as follows, *viz.* to the first eight, he gave 333 dollars each: to the ninth, he gave as much lacking 1000 dollars as to the other eight; I demand the value of the estate; and also the ninth son's share.
Value of the estate 4328 dolls.
The 9th son's share 1664 dolls.

3d. A man sheared 364 sheep, six years successively, each sheep neated 3 pounds of wool per year: how much wool had he yearly; and how much in six years?
Ans. Yearly 1092 pounds.
In six years 6552 pounds.

4th. I sold 342 tons of Iron at 142 dollars per ton: I demand the price of the whole.
Ans. 48564 dolls.

5th. I sold 742 thousand of boards in the W. I. at 62 dollars per thousand; what did they come to?
Ans. 46004 dols.

SIMPLE DIVISION.

Simple Division teaches to find how many times a smaller number is contained in a larger.

The number given to be divided is called the dividend.

The number given to divide by, is called the divisor.

That number which expresses the number of times, that the divisor is contained in the dividend, is called the quotient, or answer.

If any thing is left after dividing, it is called the remainder.

CASE I.

When the divisor is more than 12.

Rule. Write down the dividend; on the right and left draw a curved line; on the left hand of the dividend write down the divisor; seek how many times the divisor can be had in a competent number of the first figures of the dividend, and place the figure expressing the number of times, at the right of the dividend; multiply the divisor by the same figure, and place the product under the first figures of the dividend, and subtract them therefrom: to the remainder bring down the next figure of the dividend, and divide as before; and thus proceed until all the figures of the dividend are brought down. If at any time when you have brought down a figure the sum is still less than the divisor, a cypher must be placed in the quotient, and another figure must be brought down. The remainder must always be less than the divisor.

Examples.

```
         Dividend.
Divisor.16)912345(57021 Quo.
           80
           ---
           112
           112
           ---
             34
             32
             --
              25
              16
              --
               9 Remainder.
```

```
         Dividend.
Divisor.24)3102134(129255 Quo.
           24
           --
            70
            48
            --
            222
            216
            ---
              61
              48
              --
              133
              120
              ---
               134
               120
               ---
                14 Rem.
```

N. B: To prove Simple Division: Rule. Multiply the quotient and divisor together, to the product add the remainder, (if there is any,) and the sum of the product and remainder, will be like the dividend, if the work is right.

Examples.

Quo. Divr. Rem.

1st. *Question.* 57021 × 16 + 9 = 912345 as the dividend.

Questions.

	Dividends.		*Divisors.*		*Quotients.*	*Remainders.*
1st.	1432400	÷	222	=	6452	56
2d.	2045600	÷	900	=	2272	800
3d.	9400032	÷	203	=	46305	117
4th.	9320143	÷	4000	=	2330	143
5th.	7345681	÷	5566	=	1319	4127
6th.	5432140	÷	2345	=	2316	1120
7th.	6041231	÷	9760	=	618	9551

CASE II.

When there are cyphers at the right of the divisor.

Rule. Cut off the cyphers, and also cut off as many figures, or cyphers from the right of the dividend: divide as before, and to the right of the remainder, place the figures which were cut off from the dividend.

Examples.

Note. To divide by 10, 100, 1000, &c. is to cut off as many figures from the right of the dividend as there are cyphers in the divisor.

Thus, 1742 divided by 10 is $174\frac{2}{10}$
1876 divided by 100 is $18\frac{76}{100}$ *Ans.*

1st. Divide 6100000 by 610.

```
61,0)610000,0(10000
     61
     ------
      0000,0
```

2d. Divide 764213 by 12000 = *Ans.* $63\frac{8213}{12000}$.

3d. Divide 943217 by 5000 = *Ans.* $188\frac{3217}{5000}$.

4th. Divide 674321 by 11200 = *Ans.* $60\frac{2321}{11200}$.

5th. Divide 432132 by 9200 = *Ans.* $46\frac{8932}{9200}$.

Practical Questions.

1st. A man had an estate valued at 2474 dolls. and it was divided equally between twelve sons: I demand the share of each. *Ans.* \$ $206\frac{2}{12}$.

2d. If a tax of 40000 dollars were to be levied upon 1200 polls: I demand what one poll would pay. *Ans.* \$ $33\frac{400}{1200}$.

3d. Divide 1474 dollars equally among 25 men, 30 women, 17 boys, and 27 girls: after taking out 75 dollars for a present to a nephew.

Ans. \$ $14\frac{13}{99}$.

4th. Divide 247600 pounds of beef equally among an army of 23724 men. *Ans.* $10\frac{10360}{23724}$ lb.

5th. Sixty men at a feast, which lasted 3 days, spent 240 dollars per day; how much did each man spend per day, and how much in the whole?

Each man spent per day \$ 4.
Each spent in the whole \$ 12.

6th. On a muster day, 9450 lbs. of beef were provided, to dinner 27 Regiments, which consisted of 7 companies each, and each company 100 men: I demand the quantity of beef that each man had.

Ans. 8 oz.

7th. If 10500 dollars are given for 750 barrels of flour; I demand the price of one barrel.

Ans. \$ 14.

8th. If 45 horses were sold in the West Indies for 9900 dollars, I demand the average price.

Ans. \$ 220 each.

* * *

SHORT DIVISION.

Short Division is when the divisor is under 12.

Rule. Seek how many times the divisor is contained in a competent number of the figures on the left hand of the dividend, and set the figure expressing that number underneath, and all that is over must be called so many tens, and after annexing the next figure of the dividend to the remainder, divide as at first; and thus proceed through the whole, and the quotient will be placed under the dividend.

Examples.

2)423(1	3)4567(1	4)61234(2	5)1234567(2
211 *Ans.*	1522 *Ans.*	15308 *Ans.*	246913 *Ans.*
2	3	4	5
423 *Proof.*	4567 *Proof.*	61234 *Proof.*	1234567 *Proof.*
6)64567(	7)12345(	8)43213(	9)764321(

COMPOUND ADDITION.

Compound Addition teaches to add different denominations together; such as dollars, cents and mills. Tons, cwts. qrs. lbs. &c. &c.

RULE. Write down dollars under dollars; cents under cents; mills under mills. Tons under tons; hundreds under hundreds; pounds under pounds, &c. always observing to write every denomination under that of the same name; begin to add in the lowest denomination mentioned; find the sum of that denomination; divide that sum by the number which it takes of this denomination, to make one of the next higher; set down the remainder, and carry the quotient to the next denomination; find the sum of the next and proceed as before through all the denominations; observing to set down the whole sum of the last denomination.

AMERICAN MONEY.

10 Mills make	1 Cent.	-	Marked	- *m.* *c.* or *cts.*
10 Cents make	1 Dime.	-	do.	- *d.*
10 Dimes make	1 Dollar.	-	do.	- *D.* or *$.*
100 Cents make	1 Dollar.	-	do.	- *D.* or *$.*
10 Dollars make	1 Eagle.	-	do.	- - *E.*

AMERICAN MONEY.

E.	D.	cts.	m.	E.	D.	cts.	m.	D.	cts.	m.
126	8	76	4	1234	4	43	6	4567	79	8
21	4	32	1	321	3	46	5	4347	86	7
2	3	45	6	464	5	43	2	7451	75	6
22	4	32	4	364	6	34	1	3321	99	4
173	0	86	5	2384	9	67	4	19689	41	5

Practical Questions.

1st. Add together $21,71 cts. $63,42 cts. $84,96 cts.
Ans. $170,09 cts.

2d. A owes me $91,64 cts. 7 m. B $102,75 cts. and C $21,42 cts.; what do they all owe me?
Ans. $215,81 cts. 7 m.

3d. A owes B $91,73 cts. C $112,41 cts. and D $119,91 cts.: I demand what he owes to B, C and D.
Ans. $324 05 cts.

4th. A has a demand upon B for $642,20 cts. upon C for $219 and upon D $750,94 cts.; I demand the sum of his demands. *Ans.* $1612,14 cts.

5th. A farmer sold 3 yokes of oxen; for one yoke he received $105, one $117,75 cts. and one $95,55; what did they all come to? *Ans.* $318,30 cts.

6th. What is the value of 3 ships, valued as follows, viz. one $4750, one $6742 and one $7891? *Ans.* $19383.

TROY WEIGHT.

24 Grains make	1 Pennyweight. -	marked	-	*gr. pwt.*
20 Pennyweights	1 Ounce. -	do.	-	*oz.*
12 Ounces	1 Pound. - - -	do.	-	*lb.*

Examples.

lb.	*oz.*	*pwt.*	*gr.*	*lb.*	*oz.*	*pwt.*	*gr.*
245	10	19	23	2345	11	19	23
146	11	16	20	123	7	8	9
145	2	0	7	34	5	16	17
538	0	17	2	2504	1	5	1

N. B.—By Troy weight, is weighed gold, silver, &c.

Practical Questions.

1st. A man has one wedge of gold weighing 25 lb. 3 oz. 12 pwt. and another weighing 1 lb. 11 oz. 12 pwt. 7 gr.; I demand the weight of the two.

Ans. 27 lb. 3 oz. 4 pwt. 7 gr.

2d. What is the weight of the following silver articles, viz. one spoon weighing 1 lb. 10 oz. 19 pwt.; one tankard weighing 4 lb. 6 oz.; one basin weighing 1 lb. 10 oz. 19 pwt.? *Ans.* 8 lb. 3 oz. 18 pwt.

AVOIRDUPOIS WEIGHT.

By this weight is weighed sugar, iron, steel, dye woods, and all drossy metals; hay, flour, and many other things.

16 Drams make	-	1 Ounce.	-	marked	- *dr. oz.*
16 Ounces "	-	1 Pound.	-	do.	- *lb.*
28 Pounds "	-	1 Quarter.	-	do.	- *qr.*
4 Quarters "	-	1 Hundred.	-	do.	- *cwt.*
20 Cwt. "	-	1 Ton.	-	do.	- *ton.*

Examples.

Tons.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*	*Tons.*	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
444	12	1	12	2	13	123	12	2	22	10	12
41	11	0	10	12	13	321	19	3	27	15	15
123	19	3	12	15	15	141	12	2	19	11	12
610	3	1	7	15	9	587	5	1	14	6	7

Practical Questions.

1st. Add together the following parcels, viz. 12 cwt. 2 qr. 17 lb.; 1 ton, 19 cwt. 3 qr. 27 lb. 15 oz. 15 dr.; and 2 tons, 12 cwt. 2 qr. 20 lb. 12 oz. 10 dr.

Ans. 5 tons, 5 cwt. 1 qr. 9 lb. 12 oz. 9 dr.

2d. What is the weight of three hhd. of sugar, weighing as follows, viz. 1st, 9 cwt. 3 qr. 12 lb.; the 2d. 10 cwt. 1 qr. and 12 lb.; and the 3d. 8 cwt. 3 qr. 27 lb.

Ans. 29 cwt. 0 qr. 23 lb.

APOTHECARIES' WEIGHT.

20 Grains make	-	1 Scruple.	-	marked	-	gr. sc.
3 Scruples "	-	1 Dram.	-	"	-	dr.
8 Drams "	-	1 Ounce.	-	"	-	oz.
12 Ounces "	-	1 Pound.	-	"	-	lb.

Examples.

lb.	*oz.*	*dr.*	*sc.*	*gr.*	*lb.*	*oz.*	*dr.*	*sc.*	*gr.*
23	6	7	2	19	121	11	7	2	19
10	5	4	1	10	911	2	6	1	11
11	0	3	2	11	191	1	4	1	9
45	1	0	1	0	1224	4	2	2	19

Practical Questions.

1st. Add together 22 lb. 0 oz. 1 dr. 2 sc. 13 gr.; 12 lb. 0 oz. 6 dr. 2 sc. 19 gr.; and 22 lb. 1 dr. 1 sc. 19 gr.

Ans. 56 lb. 1 oz. 2 dr. 1 sc. 11 gr.

2d. Add together 11 lb. 11 oz. 6 dr. 2 sc. 12 gr.; 21 lb. 6 oz. 6 dr.; and 122 lb. 9 oz. 2 dr. 1 sc. 10 gr.

Ans. 156 lb. 3 oz. 7 dr. 1 sc. 2 gr.

LONG MEASURE.

By this measure is measured distances, &c.

3	Barley Corns	make	1 Inch.	marked	-	*bar. in.*
12	Inches	"	1 Foot.	"	-	*ft.*
3	Feet -	"	1 Yard.	"	-	*yd.*
5½	Yards -	"	1 Rod.	"	-	*rd.*
16½	Feet -	"	1 Rod.	"	-	*rd.*
40	Rods -	"	1 Furlong.	"	-	*fur.*
8	Furlongs	"	1 Mile.	"	-	*M.*
3	Miles -	"	1 League.	"	-	*lea.*
60 69½	Geographical or Statute Miles	}	1 Degree of the Earth's great Circle.	- marked	-	*deg.*
360	Degrees make	-	1 Circle	"	-	*cir.*

Examples.

Deg.	*St. m.*	*fur.*	*rd.*	*ft.*	*in.*	*bar.*
122	68	6	30	13	10	2
211	10	4	20	15	9	1
31	6	2	39	14	2	2
21	37	3	4	12	1	2
386	53½	1	16	8½	0	1

Miles.	*fur.*	*rd.*	*yd.*	*ft.*
240	7	39	4	2
213	6	11	2	1
12	4	31	2	2
144	2	22	4	1
611	5	25	3	0

Practical Question.

1st. The distance from A to B, is 3 miles 6 fur. 27 rods; from B to C, is 1 lea. 2 miles, 7 fur.; from C to D, 27 lea. 1 mile, 2 fur. 39 rods; I demand the distance from A to D. *Ans.* 30 lea. 2 mi. 0 fur. 26 rods.

LAND, OR SQUARE MEASURE.

144	Inches	make	-	1 Foot.	-	marked		*in. ft.*
9	Feet	"	-	1 Yard.	-	"	-	*yd.*
30¼	Yards	"	-	1 Rod.	-	"	-	*rd.*
272¼	Feet	"	-	1 Rod.	-	"	-	*rd.*
40	Rods	"	-	1 Rood.	-	"	-	*rood.*
4	Roods	"	-	1 Acre.	-	"	-	*acre.*
160	Rods	"	-	1 Acre.	-	"	-	*acre.*

Examples.

Acres.	*roods.*	*rds.*	*ft.*	*in.*
272	3	39	216	123
142	2	26	270	143
123	1	10	16	43
321	0	7	8	139
860	0	3	240¾	16

Acres.	*roods.*	*rds.*
212	2	29
148	2	29
143	2	10
341	3	39
846	3	27

Practical Questions.

1st. A man has several fields of land; the 1st, contains 27 acres 3 roods; the 2d, 19 acres 2 roods, 27 rods, 17 feet ; and the 3d, 6 acres, 2 roods, 39 rods ; I demand the quantity in the 3 fields.

Ans. 54 acres, 26 rods, 17 feet.

2d. Add together 64 acres, 2 roods, 39 rods ; 61 acres, 3 roods, 17 rods ; and 104 acres, 2 roods, 22 rods.

Ans. 231 acres, 0 roods, 38 rods.

Wine Measure.

By this measure, are measured wine, rum, gin and almost every thing that is sold by the gallon, &c.

4 Gills	- make -	1 Pint.	- marked	-	*gil. pt.*
2 Pints	- "	1 Quart.	"	-	*qt.*
4 Quarts	- "	1 Gallon.	"	-	*gal.*
42 Gallons	- "	1 Tierce.	"	-	*tier.*
63 Gallons	- "	1 Hogshead.	"	-	*hhd.*
84 Gallons	- "	1 Puncheon.	"	-	*pun.*
126 Gallons, or 2 hhds. }	"	1 Pipe.	"	-	*pipe.*
2 Pipes, or 252 gal. }	"	1 Tun.	"	-	*tun.*

N. B.—A wine gallon contains 231 solid inches.

Examples.

Pun.	*gal.*	*qt.*	*pt.*
143212	38	3	1
43200	71	1	0
32111	21	2	1
272	10	1	0
218796	58	0	0

Pipes.	*hhd.*	*gal.*	*qt.*	*pt.*
123	1	62	3	1
43	1	41	2	0
4	0	21	1	1
3	1	17	3	0
175	1	17	2	0

Practical Question.

1st. What is the sum of the following parcels, viz. 19 gal. 2 qt. 1 pt. ; 12 gal. 1 qt. ; 21 gal. 3 qt. and 1 hhd. 3 gal. ?

Ans. 1 hhd. 56 gal. 2 qt. 1 pt.

ALE AND BEER MEASURE.

2	Pints	make	-	1 Quart.	marked	-	*pt. qt.*
4	Quarts	"	-	1 Gallon.	"	-	*gal.*
8	Gallons	"	-	1 Firkin Ale.	"	-	*A. fir.*
9	do.	"	-	1 do. Beer.	"	-	*B. fir.*
36	do.	"	-	1 Barrel.	"	-	*bbr.*
1½	bbr. or 54 G.	"	-	1 hhd.	"	-	*hhd.*
3	Barrels	"	-	1 Butt.	"	-	*butt.*

One ale or beer gallon contains 282 solid inches.

Hhd.	*gal.*	*qt.*	*pt.*
22	51	3	1
91	52	2	1
9	43	1	0
6	41	2	1
131	21	1	1

Bbr.	*gal.*	*qt.*	*pt.*
122	31	3	1
920	33	3	1
91	15	1	1
9	29	2	1
1145	2	3	0

Practical Question.

1st. A brewer has on hand 33 hhd. 51 gal. 2 qt. of beer, and he sold to A 4 hhd. 52 gal. 2 qt. to B 19 hhd. 16 gal.; how much is the sum of what he has sold?

Ans. 24 hhd. 5 gal. 2 qt.

SOLID MEASURE.

By this is measured all such things as have length, breadth and thickness; such as stone, timber, &c. &c.

1728	Inches	make	-	1 Foot.	marked	-	*in. ft.*
27	Feet	"	-	1 Yard.	"	-	*yd.*
40	Feet of round, or 50 Feet of hewn Timber			1 Ton, or Load.	"	-	*ton.*

Examples.

Hewn tons.	*ft.*	*in.*
222	49	1721
321	36	246
26	41	1060
9	36	1259
581	14	776

Yds.	*ft.*	*in.*
234	26	1727
678	21	1672
565	20	1242
69	21	43
1549	9	1228

Practical Questions.

1. What is the sum of the three following sticks of timber, viz. the 1st, 3 tons, 49 ft. 1672 inches; the 2d, 4 tons, 47 ft. and 1000 in.; the 3d, 6 tons, 40 ft. 1001 in.? *Ans.* 15 tons, 38 ft. 217 in.

2. Add together the following parcels, viz. 29 tons, 30 ft.; 56 tons, 39 ft. 127 in.; 61 tons, 19 ft.; and 71 tons, 27 ft. 1649 in.

Ans. 219 tons, 36 ft. 48 in.

WOOD MEASURE.

Wood is bought and sold by the cord, or foot: a foot of wood contains 16 solid feet, or one eighth of a cord.

1728 Inches	make	1 Foot.	marked	*in. ft.*
16 Solid Feet	"	1 Foot of wood.		*ft.*
8 Feet of wood	"	1 Cord.	marked	*cord.*
128 Solid Feet	"	1 Cord.	"	*cord.*

Examples.

Cords.	*feet.*	*in.*
9	127	1642
2	100	642
40	50	60
61	11	9
114	33	625

Cords.	*feet.*	*in.*
64	90	146
9	10	140
70	80	90
10	21	31
154	73	407

Practical Questions.

1. Add together the following parcels of wood, viz. 64 cords, 120 feet; 72 cords, 21 feet; and 122 cords. *Ans.* 259 cords, 13 s. ft.

2. Add 3 cords 4 feet, of wood, 12 solid feet; 6 cords 5 feet of wood, and 12 solid feet; 9 cords and 6 feet of wood together.

Ans. 20 cords, 8 s. ft.

DRY MEASURE.

By this measure is bought and sold corn, and all kinds of grain; salt, &c. &c. 268·8 solid or cubic inches make one gallon of corn, &c.

2 Pints	- make	-	1 Quart.	- marked	*pt. qt.*
4 Quarts	"	-	1 Gallon.	"	*gal.*
2 Gallons	"	-	1 Peck.	" -	*pk.*
8 Quarts	"	-	1 Peck.	" -	*pk.*
4 Pecks or 32 qts.			1 Bushel.	" -	*bu.*
8 Bushels	- make		1 Quarter.	" -	*qr.*
36 Bushels	- "	-	1 Chaldron.	" -	*ch.*

Examples.

Ch.	*bu.*	*pks.*	*gal.*	*qts.*	*pts.*
654242	32	2	1	2	0
52312	31	0	0	3	1
213	20	3	1	2	0
4201	11	2	0	1	1
710970	24	1	0	0	0

Qr.	*bu.*	*pks.*	*gl.*	*qts.*	*pts.*
42	7	3	1	3	1
312	6	2	0	2	0
743	2	1	1	1	0
7	6	3	0	3	1
1106	7	3	0	2	0

Practical Questions.

1. Add together the following parcels, viz. 1627 bushels, 3 pks. 7 qrs. 1 pt.; 972 bu. 2 pks. 1 qt.; 2471 bu. 1 pk. 2 qts. 1 pt.

Ans. 5071 bu. 3 pks. 3 qts.

CLOTH MEASURE.

By this measure is bought and sold all kinds of cloths.

4 Nails	- make -	1 Quarter.	- marked	*na. qr.*
4 Quarters	" -	1 Yard.	" -	*yd.*
3 Quarters	" -	1 Ell Flemish.	" -	*E. Fl.*
5 Quarters	" -	1 Ell English.	" -	*E. E.*
6 Quarters	" -	1 Ell French.	" -	*F. E.*

Examples.

F. E.	*qr.*	*na.*	*E. E.*	*qr.*	*na.*	*E. Fl.*	*qr.*	*na.*	*Yds.*	*qr.*	*na.*
6543	5	1	244	4	3	246	2	2	126	3	3
3454	4	3	312	3	1	234	0	2	245	3	3
6543	3	2	121	1	2	121	2	1	213	1	0
6543	2	1	200	3	3	303	2	1	123	1	3
23085	3	3	879	3	1	905	1	2	709	2	1

Practical Questions.

1. Add together the following pieces of cloth, viz. 29 yards, 3 quarters, 2 nails; 30 yards, 1 quarter, 3 nails; 36 yards, 1 quarter, 1 nail; and another piece containing as much as all the others.

Ans. 203 yd. 1 qr.

2. How many French ells in the following pieces, viz. the 1st, 22 quarters, 3 nails; the 2d, 31 quarters, 1 nail; the 3d. 50 quarters, 2 nails; the 4th, 91 quarters, 1 nail. *Ans.* 32 French ells, 3 qr. 3 na.

OF TIME.

Time is measured by seconds, minutes, hours, days, weeks, months, years, &c.

60 Seconds	make	1 Minute.	marked	*sc. m.*
60 Minutes	"	1 Hour.	"	*h.*
24 Hours	"	1 Day.	"	*d.*
7 Days	"	1 Week.	"	*w.*
4 Weeks	"	1 Month.	"	*M.*
13 Months	"	1 Lunar year.	"	*year.*
12 Solar months	"	1 Year.	"	*year.*
365 Days 5 hours, 48 minutes, 57 seconds,	make	1 Solar year.		

N. B.—When any year can be divided by 4 without a remainder, it is leap year; and February has 29 days.

Exam.—*A. D.* 1808 ÷ 4 = 452 *and was leap year.*

Example.

Lunar yrs.	*mo.*	*w.*	*d.*	*h.*	*m.*	*s.*	*yrs.*	*mo.*	*d.*	*h.*	*m.*	*s.*
123	11	0	6	23	59	59	12	12	27	23	59	59
123	11	1	4	21	20	40	19	9	4	11	12	11
191	12	3	2	11	12	10	21	4	6	1	10	9
251	11	1	2	10	10	9	41	2	4	6	9	40
691	7	3	2	18	42	58	95	2	14	18	31	59

Practical Questions.

1. Add together 12 years, 6 mo. 3 w. 6 d. 23 h. 12 m. 42 s.; 49 years, 5 mo. 2 w. 4 d. 12 h. 9 m.; 1 year, 9 mo. 1 w. 1 d. 1 h. 6 m.

Ans. 63 years, 8 mo. 3 w. 5 d. 12 h. 27 m. 12 s.

COMPOUND SUBTRACTION.

Compound Subtraction teaches to find the difference between a larger and a smaller number, which have several denominations.

Rule.—Write down the largest of the two numbers, and under it, write down the smallest; observing to place every denomination under that of the same name; dollars under dollars, &c.; begin to subtract in the lowest denomination, take the lower from the upper line; if any particular figures in the lower line in any of the denominations, are larger than those over them, subtract the lower figures from the number that it takes of this, to make one of the next higher denomination; and to the remainder add the top figures, and set them down, and carry one to the next denomination to be added to the lower line: proceed thus through all the denominations.—*Proof.* Add together the remainder and lower line, carry as in Compound addition; the sum will be like the upper line if the work is right.

AMERICAN MONEY.

Dolls.	cts.	m.	Dolls.	cts.	m.	Dolls.	cts.	m.
1241	79	9	4312	29	7	1000	00	0
992	87	8	704	21	6	999	99	9
248	92	1	3608	8	1			1

Practical Questions.

1. A man lent 3 E. 3 Dolls. 3 d. 3 c.; and received 2 E. 2 Dolls. 99 cts. and 9 mills; How much remains due?

Ans. 10 dolls. 33 cts. 1 m.

2. A man had an estate valued at 3505 dolls. 6 d. 3 cts. 2 ms.; he had three sons, to each of whom he gave 504 dolls. 5 cts. 2 ms.; also he gave to two daughters, 75 dolls. 75 cts. each: What had he left?

Ans. 1841 dolls. 97 cts. 6 m.

3. A man was supposed to be worth 9472 dolls. 65 cts.; by a misfortune at sea, he lost 4549 dolls. 75 cts; what was he worth after he sustained the loss?

Ans. 4922 dolls. 90 cts.

TROY WEIGHT.

lb.	*oz.*	*pwt.*	*grs.*
223	10	19	22
124	11	12	23
98	11	6	23

lb.	*oz.*	*pwt.*	*grs.*
31234567	6	12	20
13432148	10	13	22
17802418	7	18	22

Practical Questions.

1. A person had a basin which weighed 3 lb. 10 oz.; It being melted in part, it then was weighed again, and its weight was 2 lb. 11 oz. 7 pwt. 4 grs.: I demand what was melted off. *Ans.* 10 oz. 12 pwt. 20 grs.

2. A Silver Smith had a quantity of silver, its weight was 21 lbs. 9 oz.; he refined it by melting, and then weighed it again, and its weight was 15 lb. 10 oz. 11 pwt. 19 grs.; I demand what was lost by melting.

Ans. 5 lb. 10 oz. 8 pwt. 5 grs.

3. How much silver must be given in exchanging a silver plate for a platter; the weight of the platter being 2 lb. 10 oz.; and the weight of the plate 1 lb. 4 oz. 7 pwt.?

Ans. 1 lb. 5 oz. 13 pwt.

AVOIRDUPOIS WEIGHT.

tons.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
12	19	2	27	14	14
9	18	3	24	15	15
3	0	3	2	14	15

tons.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
134	12	3	20	13	12
94	19	2	21	14	15
39	13	0	26	14	13

Practical Questions.

1. 22 tons, 13 cwt. 1 qr. of Iron being on board a vessel, and in a gale of wind she was lightened by throwing a part of her cargo overboard; the cargo was weighed when she arrived at port, and its weight was 15 tons, 1 qr.: I demand the quantity that was lost.

Ans. 7 tons, 13 cwt.

2. A merchant had 1 ton, 3 qr. 27 lb. of sugar, it was all stolen but 1 cwt. 1 qr. 8 lb.: I demand the quantity stolen. *Ans.* 19 cwt. 2 qr. 19 lb.

3. I bought 27 cwt. 2 qr. 19 lb. of flour, and sold 19 cwt. 3 qr. 27 lb.: what remains on hand? *Ans.* 7 cwt. 2 qr. 20 lb.

APOTHECARIES' WEIGHT.

lb.	*oz.*	*dr.*	*sc.*	*grs.*
14	10	6	2	19
6	11	7	1	16
7	10	7	1	3

lb.	*oz.*	*dr.*	*sc.*	*grs.*
123	6	1	1	19
94	11	6	2	17
28	6	2	2	2

Practical Questions.

1. An Apothecary had 12 lb. 6 oz. 2 dr. of medicine in a certain vessel; by accident the vessel was broken, and there remained in a broken piece of the vessel, 8 lb. 11 oz. 7 dr. 1 sc. 13 grs.: I demand the quantity which was lost. *Ans.* 3 lb. 6 oz. 2 dr. 1 sc. 7 grs.

2. What remains after taking 19 lb. 6 oz 3 dr. from 26 lb. 7 oz. 7 dr.? *Ans.* 7 lb. 1 oz. 4 dr.

3. What is the difference between 119 lb. 6 oz. and 111 lb. 11 oz.? *Ans.* 7 lb. 7 oz.

LONG MEASURE.

Deg.	*mi.*	*fur.*	*rds.*	*ft.*	*in.*	*bar.*
27	59	6	30	15	11	2
9	27	7	35	13	9	2
18	31	6	35	2	2	0

M.	*fur.*	*rds.*	*ft.*	*in.*	*bar.*
224	3	21	13	1	1
95	6	32	14	9	2
128	4	28	14½	3	2

Practical Questions.

1. Subtract 24 mi. 3 fur. 26 rds. from 26 mi. and shew the difference. Ans. 1 mi. 4 fur. 14 rds.

2. Express the difference between 200 mi. 6 fur. 29 rds.; and 150 mi. 7 fur. 2 rds. 4 yds. 2 ft. 1 bar.
Ans. 49 mi. 7 fur. 26 rds. ½ yd. 11 in. 2 bar.

3. Express the difference between 7 lea. 2 mi. 6 fur. 27 rods; and 5 lea. 1 mi. 7 fur. 30 rds.

Ans. 2 lea. 0 mi. 6 fur. 37 rds.

4. A man was payed for hauling a ton of goods a certain sum per mile, for 51 miles 4 furlongs: the distance was afterwards found to be 60 miles 2 furlongs; what was the distance for which he was not payed?

Ans. 8 mi. 6 fur.

LAND, OR SQUARE MEASURE.

Acres	*roods*	*rds.*	*ft.*
126	1	39	16
112	3	30	14
13	2	9	2

Acres	*roods*	*rds.*	*ft.*	*in.*
2456	1	12	10	11
1367	2	22	9	7
1088	2	30	1	4

Practical Questions.

1. A man's farm contained 246 acres, 1 rood, 7 rods: he sold to A. 27 acres, 2 roods, 1 rod; to B. 39 acres, 39 rods; and to C. 50 acres, 2 roods; how much had he left?

Ans. 129 acres, 7 rods.

2. A man had 700 acres of land: he had 4 sons, to the first he gave 60 acres 2 roods, to the second half as much; to the third and fourth he gave as much as to the second; how much had he left after settling his sons?

Ans. 548 acres, 3 roods.

3. A man had 3472 feet 142 inches of boards, he sold 1249 feet 126 inches: what had he left?

Ans. 2223 feet, 16 inches.

WINE MEASURE.

Pun.	*gal.*	*qts.*
12345	70	3
10947	75	2
1397	79	1

Pipes	*hhds.*	*gal.*	*qts.*	*pt.*
23	1	60	2	1
19	0	59	3	0
4	1	0	3	1

Practical Questions.

1. A wine seller bought 22 hhds. 54 gal. of wine ; he sold 12 hhds. 60 gallons ; I demand the quantity left.

Ans. 9 hhds. 57 gal.

2. I bought 2 hhds. of rum which contained 247 gal. 3 qts. 1 pt.; by moving them they sprang aleak; I drew them off as soon as possible, but could draw out but 198 gal. 2 quarts ; I demand the quantity that was lost.

Ans. 49 gal. 1 qt. 1 pt.

3. I demand the difference between 3 pipes, 1 hhd. 54 gallons, and 1 pipe, 1 hhd. 61 gallons.

Ans. 1 pipe 1 hhd. 56 gal.

SOLID MEASURE.

Hewn tons	*ft.*	*in.*
246	49	1720
179	46	1723
67	2	1725

Hewn tons.	*ft.*	*in.*
12	16	1111
9	49	1727
2	16	1112

Practical Questions.

1. A man had lying in the dock, 249 tons, 12 feet of round timber ; in a high tide a part of it went adrift ; there remained in the dock 142 tons, 12 feet, 1721 inches ; I demand the quantity lost. Ans. 106 tons, 34 ft. 7 in.

2. What is the difference between 49 tons 39 feet ; and 27 tons, 38 feet, 1272 inches ?

Ans. 22 tons, 0 feet, 456 inches.

3. A stone-hewer had on hand 1427 feet of stone ; he sold 192 feet, 1427 inches ; I demand the quantity left.

Ans. 1234 feet, 301 inches.

WOOD MEASURE.

cords.	*sd. feet.*
1346	127
1297	121
49	6

cords.	*sd. feet.*
1327	120
1319	101
8	19

cords.	*sd. feet.*
2456	11
1341	125
1114	14

Practical Questions.

1. A woodseller bought 127 cords, 120 solid feet of wood, and sold 100 cords, 101 solid feet: how much had he left on hand? *Ans.* 27 cords, 19 feet.

2. A coaster loaded his vessel with 65 cords, 118 solid feet of wood; in a storm he was obliged to light her by throwing wood overboard; when she arrived in port, there was but 21 cords, 106 sd. feet on board: I demand the quantity lost. *Ans.* 44 cords, 12 feet.

3. What is the difference between 27 cords, 104 feet; 19 cords, and 125 feet? *Ans.* 7 cords, 107 feet.

DRY MEASURE.

chal.	*bu.*	*pks.*	*gals.*	*qts.*	*pt.*
224	30	2	1	3	1
19	35	3	0	2	0
204	30	3	1	1	1

chal.	*bu.*	*pks.*	*qts.*	*pt.*
3456	27	3	6	0
1967	30	2	7	1
1488	33	0	6	1

Practical Questions.

1. What is the difference between 7953 chal. 13 bushels; and 3789 chal. 35 bushels? *Ans.* 4163 chal. 14 bu.

2. A merchant in Boston had a vessel coming from Virginia loaded with 2478 bushels, 3 pks. of corn; in a storm she was lighted by shoveling corn overboard; on her arrival in port, she had but 2027 bushels, 1 pk. on board: I demand the quantity lost. *Ans.* 451 bu. 2 pks.

CLOTH MEASURE.

Fr. E.	*qr.*	*na.*
12	4	3
9	5	3
2	5	0

En. E.	*qr.*	*na.*
21	4	3
19	3	3
2	1	0

Yds.	*qr.*	*na.*
121	3	2
109	2	3
12	0	3

Practical Questions.

1. A dealer in clothes had 3 pieces containing in all 80 yards, 3 qrs.; he sold 51 yards, 3 qrs. 3 nails; I demand what he had left. Ans. 28 yds. 3 qr. 1 na.

OF TIME.

Lunar year	*mo.*	*w.*	*d.*	*h.*	*m.*	*sc.*
21	12	3	6	12	21	22
19	10	2	5	15	30	40
2	2	1	0	20	50	42

Year	*d.*	*h.*
125	321	12
109	329	21
15	356	15

Practical Questions.

1. A man hired an other, for 2 years, 6 months; he stayed 1 year, 10 months, and went away; I demand how long before his time would have been out did he go away? Ans. 8 months.

CASE II.

To find the difference between any year, month, and day of the month: and any other year, month, and day of the same.

☞ *Observe the following Table.*

January	is the first month.	July	is the seventh month
February	2d	August	8th
March	3d	September	9th
April	4th	October	10th
May	5th	November	11th
June	6th	December	12th.

Rule. Write down the latest date first, (consider whether the month is the first, second, or third, &c. if it is January, write 1 for months; if it is February, write 2; if March 3, &c. and after it write the day of the month) and then write down the other numbers under those of the same denomination; subtract, and the remainder is the difference between the two dates.

N. B. By this method each month is considered to contain only 30 days, which would perhaps be exact enough for business; although 5 days would be lost in a year.

Examples.

1. What is the difference of time between the 16th day of February 1800; and the 19th day of May 1806?

Years.	*mo.*	*d.*	
1806	5	19	
1800	2	16	
6	3	3	Answer.

N. B. In this example the latest year is written first, May being the fifth month, 5 is put in the column of months, and the day of the month, in the column for days: and then the other denominations are put under those of the same name.

Practical Questions.

2. How long between the 15th day of June 1729, and the 30th day of August 1806, inclusive?

Ans. 77 years, 2 mo. 15 days.

3. I was born the 7th day of May, 1777; what is my age, it being the 20th day of June 1810?

Ans. 33 years, 1 mo. 13 days.

4. A. gave B. his note on interest, dated the 21st of August 1804; on the 29th day of Nov. 1809, the note was payed: I demand the time that the note was at interest.

Ans. 5 years, 3 mo. 8 days.

DECIMAL FRACTIONS.

Decimal Fractions are parts of whole numbers, and are separated therefrom by a point called the separatrix, thus, 12 ·5 : which is 12 and 5 tenths, or $\frac{1}{2}$; all the figures which stand at the left of the separatrix are whole numbers; those on the right, are fractions. An unit is supposed to be divided into ten equal parts, and the figure next the separatrix expresses the number of those parts; again, one of these parts is supposed to be divided into ten more equal parts; and the next figure in decimals expresses the number of those parts, &c. Thus decimals decrease in a tenfold proportion, as they depart from the separatrix; thus ·5 is 5 tenths; ·05 is 5 hundreths; and ·005 is 5 thousandths, &c. Cyphers placed at the right hand of decimals do not alter their value ·5 ·50 and ·500 are decimals of the same value and equal to ·5, or five tenths, &c.

DECIMAL NUMERATION TABLE.

Milliens.	Hundred Thousands.	Ten Thousands.	Thousands.	Hundreds.	Tens.	Units.	Tenths.	Hundredths.	Thousandths.	Ten Thousandths.	Hundred Thousandths.	Millionths.
7	6	5	4	3	2	1	·1	2	3	4	5	6
	6	5	4	3	2	1	·1	2	3	4	5	
		5	4	3	2	1	·1	2	3	4		
			4	3	2	1	·1	2	3			
				3	2	1	·1	2				
					2	1	·1					
						1						

N. B. By the above table it is evident that the value of figures increase in whole numbers, as they depart from the separatrix; and in the fractions, the value of the figures decrease as they depart from the separatrix.

ADDITION OF DECIMALS.

RULE. Write down the several numbers to be added, so that units may stand under units; tens under tens; hundreds under hundreds; and the fractions must stand tenths under tenths; hundredths under hundredths, &c.

The several decimal points must stand directly under one another, then add the several sums together in the same manner as in Simple Addition. Separate the sum total by placing the separatrix under those directly above, &c.

Examples.

27·123	341·346	74·789	7·123
1·0341	91·2	7·61741	1·2
·1345	2·023	·214	10·32
28·2916	434·569	82·62041	18·643

Practical Questions.

1. Add 504·29, 64·1, 23·09 and 55·6 together.
Ans. 647·08

Note. Dimes, cents and mills are exact decimals of a dollar; one dime is one tenth; one cent is one hundreth, one mill is one thousandth: therefore the addition of American money, is the addition of decimals.

Example.

Add $ 1327·64 cents; $ 2341·96 cents 9 mills; and $ 1572·21 cents together. Ans. $ 5241·819.

SUBTRACTION OF DECIMALS.

Rule. Write down the largest of the two numbers first, then write down the smallest under it, observing to place the separatrix under each other; then subtract exactly as in Simple Subtraction.

Examples.

234·101	91·91	141·1	7·00041
145·164321	81·11234	98·3	5·19864
88.936679			

MULTIPLICATION OF DECIMALS.

Rule. Multiply exactly as in whole numbers, and from the right of the product point off as many places for decimals, as are equal to the decimal places in the multiplicand and multiplier, counted together; If at any time there are not so many places in the product, as this rule requires, supply the defect by prefixing cyphers.

Examples.

1st	2d	3d	4th	5th	6th.
1·23	10·4	123	·123	·002	·094
17·8	123	1·45	·164	·661	941
21·894	1279·2	178·35	·020172	·001322	88·454

N. B. In the 1st example there are three decimal figures in the multiplicand and multiplier, therefore three figures in the product are pointed off for decimals.

In the 2d example there is only one figure in decimals, in the multiplier and multiplicand: therefore one figure in the product is pointed off for decimals.

In the 4th example there are six figures in decimals, in the multiplier and multiplicand; and there are only 5 figures in the product; therefore one cypher is prefixed, and all are pointed off for decimals, &c.

N. B. The multiplication of decimals is the multiplication of American money, &c.

Examples.

1. How much is the product of 29·5 multiplied by ·96 cents?
Ans. $ 28·32 cents.

2. How much will 1000 pounds of butter come to, at 11½ cents per pound?
Ans. $ 115.

DIVISION OF DECIMALS.

Rule. Divide exactly as in whole numbers, and from the right hand of the product point off as many places for decimals, as the decimal places in the dividend exceed the decimal places in the divisor; If there are not so many places in the quotient as this rule requires, the defect must be supplied by prefixing cyphers to the left of the quotient; if there are more decimal places in the divisor than in the dividend, place as many cyphers to the right of the dividend, as will make them equal, and the quotient is whole numbers till the dividend is all brought down: If a remainder still remains annex cyphers and continue the division; and the quotient thence arising will be decimals.

Examples.

1. Divide 34·21 by 12·1.

```
12·1)34·21(2·827
     242
     ----
     1001
      968
      ----
      330
      242
      ----
       880
       847
       ---
        33 Remainder.
```

Note 1. In this first example there is one more decimal in the dividend, than in the divisor: I therefore pointed off one for decimals, and then annexed two cyphers, and continued the division.

2. Divide 1302 by ·101.

·101)1302·000(12891·089 *Ans.*

NOTE 2. In this example the dividend is whole numbers, and the divisor has 3 places in decimals; I therefore placed 3 cyphers to the right of the dividend before I divided, and after the dividend was all brought down, I annexed 3 cyphers to the remainder, and continued the division, &c.

3. Divide 263·146 by 1320.

1320)263·146(·199$\frac{466}{1320}$. *Ans.*

NOTE 3. In this example there are 3 decimal places in the dividend, and the divisor is whole numbers; therefore I pointed off 3 figures from the quotient, for decimals.

4. Divide ·4567 by 333.

333)·4567(·0013$\frac{238}{333}$. *Ans.*

NOTE 4. In this example, there are 4 figures in decimals in the dividend, and the divisor is whole numbers: the quotient has but 2 figures: I therefore prefixed 2 cyphers to the left of the quotient, and pointed all off for decimals.

5. Divide ·07912 by ·111.

·111)·07912(·71$\frac{31}{111}$. *Ans.*

NOTE 5. In this example there is 2 more decimal places in the dividend, than in the divisor: I therefore pointed off two places in the quotient for decimals.

6. Divide ·00444 by 222. Ans. ·00002.
7. Divide ·9023 by ·11. Ans. 8·202$\frac{8}{11}$.
8. Divide 15·735 by 12. Ans. 1·311†.*

---

* This mark (†) signifies that the remainder must be added to make the quotient complete.

REDUCTION OF DECIMALS.

CASE I.

To reduce Vulgar Fractions to Decimals.

Rule. Annex cyphers to the numerator, and divide by the denominator: the quotient is the decimal sought.

Examples.

1. Reduce $\frac{5}{6}$ to a decimal of the same value.

6)5·000

·833+ Answer.

2. Reduce $\frac{1}{2}$ to a decimal of the same value.

2)1·0

·5 Answer.

3. Reduce $\frac{1}{4}$ to a decimal of the same value.
Ans. ·25.

4. Reduce $\frac{3}{4}$ to a decimal of the same value.
Ans. ·75.

CASE II.

To reduce different denominations to decimals.

Rule. Write down the several denominations under each other: beginning with the lowest and ending with the highest: on the left of these draw a perpendicular line, and on the left of the line, place such numbers for divisors, against each denomination, as it takes of this to make one of the next higher: annex cyphers to the top figures and divide by the number standing against it on the left of the line: set the quotient (decimally) against the next denomination below; divide the next below by the number standing against it: set the quotient as before; proceed thus through all the denominations, the last quotient is the decimal sought.

Examples.

1. Reduce 19*s.* 11*d.* 3*qrs.* to the decimal of a pound.

```
 4 |  3·00
12 | 11·75
20 | 19·9791
   ---------
    ·9989† Answer.
```

2. Reduce 6 oz. 12 pwt. 15 grs. to the decimal of a pound, Troy weight.

```
24 | 15·000

20 | 12·625† 10

12 |  6·6312
   ---------
     ·5526 Ans.
```

3. Reduce 2 cwt. 3 qrs. 12 lb. 12 oz. 11 dr. to the decimal of a ton, Avoirdupois weight.

```
16 | 11·
16 | 12·
28 | 12·
 4 |  3·
20 |  2·
   ---------
    ·1432† Ans.
```

4. Reduce 3 qrs. 3 na. to the decimal of a yard, Cloth measure.

```
4 |

4 |
  ---------
  ·9375 Ans.
```

5. Reduce 2 miles 6 fur. 20 rds. 12 ft. 6 in. 2 bar. to the decimal of a league, Long measure.

3 |
12 |
16·5 |
40 |
8 |
3 |

·9382† Ans.

6. Reduce 3 roods 30 rds. 29 yds. to the decimal of an acre, Land measure.

30·25 |
40 |
4 |

·9434† Ans.

7. Reduce 56 gal. 3 qts. 1 pt. to the decimal of a hhd. allowing 63 gal. to a hhd.

2 |
4 |
63 |

·9027 Ans.

8. Reduce 39 feet 1727 inches to the decimal of a ton of round timber. Ans. ·9999†.

9. Reduce 1 pk. 2 qts. 1 pt. to the decimal of chaldron. Ans. ·0091†.

10. Reduce 12 months, 3 weeks, 6 days, 23 hours, 59 minutes, 12 seconds, to the decimal of a year. Ans. ·9999†.

11. Reduce 2 minutes to the decimal of a month of 28 days. Ans. ·00004†.

12. Reduce 1 pint to the decimal of a hhd. Wine measure. Ans. ·0019†.

13. Reduce 1 week to the decimal of a year, allowing 13 months to a year. Ans. ·01923†.

14. Reduce 1 minute to the decimal of a year of 360 days. Ans. ·000001†.

15. Reduce 1 dram to the decimal of a ton, Avoirdupois weight. Ans. ·000001†.

CASE III.

To express the value of any decimal in the several denominations of the integers.

Rule. Multiply the decimals by the next denomination, point off as many places for decimals as is required by the rule in multiplication of decimals; then multiply the last decimal by the next denomination, and so on to the last: the figures on the left of the decimal points are the value of the decimal in the parts of the integer.

Examples.

1. Required the value of ·9464 of a £.

```
    ·9464
       20
 ---------
 s.18·9280
       12
 ---------
 d.11·1360
        4
qrs.0·5440
 ---------
```

18*s.* 11*d.* 0*qr.* ·544 Answer.

2. Required the value of ·5526 of a lb. Troy weight. Ans. 6 oz. 12 pwt. 14† grains.

3. What is the value of ·1432 of a ton? Ans. 2 cwt. 3 qr. 12 lb. 12 oz. 4† gr.

4. What is the value of ·9017 of a lb. Apothecaries' weight? Ans. 10 oz. 6 dr. 1 sc. 13† grs.

5. What is the value of ·9376 of a yard?
Ans. 3 qr. 3† na.

6. What is the value of ·9436 of a league?
Ans. 2 mi. 6 fur. 25 rds. 4 yds. 2ft. 1‡ in.

7. What is the value of ·9436 of an acre?
Ans. 150† rods.

8. What is the value of ·9999 of a ton, Solid measure?
Ans. 39 ft ·1700† in.

9. What is the value of ·0099 of a chaldron?
Ans. 1 pk. 3 qts.

10. What is the value of ·0002 of a month?
Ans. 8 minutes, 3† sec.

COMPOUND MULTIPLICATION.

AMERICAN MONEY.

Compound Multiplication teaches to multiply numbers, which have different denominations together, such as dollars, cents and mills, by yds. qrs. &c.

CASE I.

Rule. Multiply the quantity and price together, the product is the answer. Observe to point off for decimals as directed in the rule of decimals.—I have before observed, that the parts of a dollar are exact decimals: *See Addition of Decimals.*——This case is to be applied where the quantity is a whole number.

Examples.

1. How much will 1000 lbs. of butter come to at ·11 cts. 5 mills per pound?

1000lbs. × ·115 = $115·000 *Ans.*

N. B. In this example, 11 cts. and 5 mills are exactly equal to 115 thousandths of a dollar: therefore, I multiply the price by the quantity, the product is 115000.: according to rule, I pointed off 3 places for decimals, the other figures are dollars.

2. How much will 349 pounds of pork come to at ·07 cts. per pound? *Ans.* 24 dolls. 43 cts.

3. How much will an ox come to, whose weight and prices are as follows, *viz.*—The quarters 205·5, 202, 207 and 200 lbs. at ·06 cts.; the hide 70 lbs. at ·07 cts.; the tallow 66 lbs. at ·09 cts. lb.

Ans. 59 dolls. 71 cts. 6 m.

4. A drover sold 100 lambs in 5 separate lots, 20 to a lot; the first lot was sold for $1·96 cts.; the second for $1·90 cts.; the third for $2·05 cts.; the fourth for $2·10 cts.; and the fifth at $2·15 cts.: I demand the price of the whole. *Ans.* $203·20 cts.

BILLS OF PARCELS.

Exeter, April 10, 1811.

Mr. A. B. bought of

Mr. C. D.

		Cts.	*Dolls.Cts.*
6 gallons of West India rum	at	·96	5·76.
7 do. of New England do.	"	·55	3·85.
12 lbs. of hyson tea	"	$1·25	15·00.
19 pairs of shoes	"	·96	18·24.
20 lbs. of coffee	"	·28	5·60.
29 lbs. of rice	"	·04	1·16.
90 lbs. of cotton	"	·23	20·70.
15 doz. biscuit	"	·15	2·25.
			$74·56.

Received payment in full,

Signed C. D.

Exeter, April 10, 1811.

Mr. J. K. of Portsmouth,

bought of Mr. G. H.

		Cts.	Dolls.	Cts.
1000 gallons of West India rum	at	$ 1·25		
900 do. of molasses	"	·60		
90 cwt. of brown sugar	"	9·50		
15 barrels of flour	"	8·25		
3 crates of ware	"	40·30		
2 cwt. of iron	"	5·60		
69 gallons of Holland gin	"	1·40		
20 cases of knives and forks	"	·75		
650 lbs. of coffee	"	·29		
			$3200	·95

Received payment by note, payable in 90 days.

Signed G. H.

CASE II.

When there are fractions in the quantity, such as $\frac{1}{2}$ $\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{8}$, &c.

Rule. Reduce the vulgar fraction to a decimal—then multiply the quantity and price together: point off for decimals according to rule: all that are on the left of the point are dollars, and all on the right are parts.

1. What will 102$\frac{3}{4}$ yards of India cotton come to at ·29 cents per yard?

Yds. *Cts.* *Dolls. cts. m.*

$\frac{3}{4}$=·75. then 102·76×·29=19·79·7·5. *Ans.*

N. B. In this example $\frac{3}{4}$ reduced to a decimal, gives two decimal places in the quantity, and there are two decimal places in the price; of course there are four places of decimals in the product; the three first figures in the decimals, are cents and mills, and the other is parts of a mill, which in business is not worth noticing.

2. What will 21½ yards of velvet come to, if 1 dollar 25 cents are paid for 1 yard?

Ans. $26·87 cts. 5 m.

3. What will 6$\frac{9}{12}$ of a yard of broadcloth come to, at 6 dolls. 75 cts. per yard?

Ans. $45·56 cts. 2½ m.

CASE III.

When there are several denominations in the quantity.

RULE. Reduce the several denominations to the decimal of the highest, by case 2, in reduction of decimals; then multiply the price and quantity together, point for decimals according to rule; the answer will be dolls. cts. and m. and parts of m.

1. How much will 3 cwt. 2 qr. 20 lbs. of sugar come to, at $12·10 per cwt.?

28 | 20·000†8.
4 | 2·714

cwt. 3·678 × 12·10 = 44 dolls. 50 cts. 3 m. [Ans.

N. B. 2 qr. 20 lb. reduced to the decimal of a cwt. is equal to 678 thousandths, which I annex to the hundreds, and multiply by the price.

2. How much will 173 cwt. 3 qr. 27 lb. of iron come to, at $5·51 cts. per cwt.? *Ans.* $958·69 cts. 1† m.

3. How much will 356 acres, 1 rood, and 7 rods of land come to at $17·21 cts. per acre?

Ans. $6131·80 cts. 2† m.

4. What will 64 tons, 3 cwt. of potash come to, at $84 50 cts. per ton? *Ans.* $5420·67 cts. 5 m.

5. What will 38 cwt. 3 qr. 21 lbs. of sugar come to, at $11·52 cts per cwt.?

Ans. $448·55 cts. 4† m.

6. What will the wages of a servant come to for 70 years, 3 months, 15 days, allowing 26 days to a month, and 12 months to a year, at $6·71 cts. 5 m. per year?

Ans. $472·05 cts. 1 m.

CASE IV.

Rules concerning boards and plank.

Boards, Plank, &c. are sold at a certain price per thousand square feet; and I here would observe, that all the feet under 1000 are exact decimals of a thousand: therefore if 6542 feet of boards, or joists were to be sold at a certain price per thousand, place the separatrix between the thousands and the hundreds, thus 6·542; and then multiply the price and quantity together, and the product, pointed as the rule requires, will be the answer in dollars and parts, &c.

NOTE. This rule holds good respecting any thing that is sold by the hundred; thus, if 174 hoops were to be sold for a certain price per hundred, place the separatrix between the hundreds and tens, thus, 1·74, and multiply the price and quantity together, the product, pointed according to rule, will be the answer in dollars and parts.

Examples.

1. How much will 10751 feet of boards come to, at $11·21 cents per thousand?

Feet *D. cts.* *D. cts. m.*
10·751 × 11·21 = 120·51·8† Ans.

2. How much will 1100 ft. of plank come to, at 33 dollars per thousand? Ans. $36·30 cts.

3. How much will 941 feet of clear boards come to at $25 per thousand? Ans. $23·52 cts. 5 m.

CASE V.

To multiply by fractional parts.

RULE. Multiply by the numerator and divide by the denominator; or reduce the vulgar to a decimal fraction, and multiply, and point off for decimals, according to the rule of decimals.

Examples.

1. What is the value of $\frac{8}{10}$ of a ship, worth $10000;
10000 × 8 = 80000 ÷ 10 = $8000 Ans.

The same question, by rule second.

$\frac{8}{10}$ ·8 × 10000 = $8000 Ans.

2. What is $\frac{5}{7}$ of a house worth, which is valued at $3470? Ans. $2478·55·1†.

CASE VI.

Weights and Measures.

When the number of casks, &c. are above twelve; multiply by two such numbers as will make the number required; if there are no such two numbers, then multiply by two such numbers as will come nearest to the number required, either over or under: then, for the difference either add, or subtract as the case may be; observe to carry as in compound addition.

Rule 2. The several denominations may be reduced to the decimal of the highest; and then multiply the number and the weight, or quantity, together; the product pointed for decimals according to rule, will be the answer required.

Example by rule 1.

1. What is the weight of 9 casks of raisins, each weighing 3 cwt. 2 qrs. 11 lb. 6 oz.?

Cwt.	*qr.*	*lb.*	*oz.*	
3	2	11	6	
			9	
32	1	18	6	Ans.

Example by rule 2.

Cwt. qr. lb. oz. Cwt. parts. Cwt. parts.

3 2 11 6 = 3·601 × 9 = 32·409 and is = 32 cwt. 1 qr. 17 lb. 12 oz. which is 9 oz. less than the true answer; and is lost in reducing the parts.

2. What is the weight of 56 casks of raisins; each weighing 1 cwt. 2 qrs. 12 lb.?

Ans. 90 cwt.

3. What is the weight of 105 casks of tobacco; each weighing 3 cwt. 1 qr. 7 lb.? Ans. 347 cwt. 3 qr. 7 lbs.

DECIMAL TABLES OF WEIGHTS AND MEASURES.

TROY WEIGHT.

Ounces reduced to the decimal of a lb.		*Pennyweights reduced to the decimal of a lb.*		*Grains reduced to the decimal of a lb.*	
6 oz.	= ·5	10 pwts.	= ·04166†	12 grs.	= ·002083†
5 ..	= ·41666†	9 ..	= ·0375	11 ..	= ·00191
4 ..	= ·33333†	8 ..	= ·03333†	10 ..	= ·001736†
3 ..	= ·25	7 ..	= ·02916†	9 ..	= .001562
2 ..	= ·16666†	6 ..	= ·025	8 ..	= ·001389
1 ..	= ·08333†	5 ..	= ·02083†	7 ..	= ·001215
		4 ..	= ·01666†	6 ..	= ·001042
		3 ..	= ·0125	5 ..	= ·000868
		2 ..	= ·00833†	4 ..	= ·000694
		1 ..	= ·00416†	3 ..	= ·000521
				2 ..	= ·000347
				1 ..	= ·000173

AVOIRDUPOIS WEIGHT.

Quarters, pounds, ounces and drams, reduced to the decimal of a cwt.

Quarters.	
1	= ·25
2	= ·5
3	= ·75
Pounds.	
14	= ·125
13	= ·1160†
12	= ·1071†
11	= ·0982†
10	= ·0892†
9	= ·0803†
8	= ·0714†
7	= ·0625
6	= ·0535

Pounds.	
5	= ·0446†
4	= ·0357†
3	= ·0267†
2	= ·0178†
1	= ·0089†
Ounces.	
8	= ·0044†
7	= ·0039†
6	= ·0033†
5	= ·0027†
4	= ·0022†
3	= ·0016†

Ounces.	
2	= ·0011†
1	= ·0005†
Drams.	
8	= ·00027†
7	= ·00024†
6	= ·00020†
5	= ·00017†
4	= ·00013†
3	= ·00010†
2	= ·00006†
1	= ·00003†

APOTHECARIES' WEIGHT.

The parts reduced to the decimal of a pound.

Ounces.	*Drams.*	*Grains.*	*Grains.*
6= ·5	4= ·1417†	10= ·0017†	4= ·0006†
5= ·4166†	3= ·0312†	9= ·0015†	3= ·0005†
4= ·3333†	2= ·0208†	8= ·0013†	2= ·0003†
3= ·25	1= ·0104†	7= ·0012†	1= ·0001†
2= ·1666†	*Scruples.*	6= ·0010†	
1= ·0833†	2= ·0069†	5= ·0008†	
	1= ·0034†		

WINE MEASURE.

The parts reduced to the decimal of a hogshead of sixty-three gallons.

Gallons.	*Gallons.*	*Gallons.*	*Quarts.*
30= ·4761†	9= ·1428†	5= ·0793†	3= ·01189†
20= ·3174†	8= ·1269†	4= ·0634†	2= ·0079†
10= ·1587†	7= ·1111†	3= ·0476†	1= ·0039†
	6= ·0952†	2= ·0317†	*Pints.*
		1= ·0158†	1= ·0019†

LONG MEASURE.

The parts reduced to the decimal of a mile.

Furlongs.	*Rods.*	*Rods.*	*Feet.*
7= ·875	18=·0562†	6= ·0187†	2= ·00037†
6= ·750	17=·0531†	5= ·0156†	1= ·00018†
5= ·625	16=·05	4= ·0125†	*Inches.*
4= ·5	15=·0468†	3= ·0093†	6= ·00009†
3= ·375	14=·0437†	2= ·0062†	5= ·00007†
2= ·25	13=·0406†	1= ·0031†	4= ·00006†
1= ·125	12=·0375†	*Yards.*	3= ·00004†
Rods	11=·0343†	4= ·0022†	2= ·00003†
20=·0625	10=·0312†	3= ·0016†	1= ·000015†
19=·0593†	9=·0281†	2= ·0011†	
	8=·025	1= ·0005†	
	7=·0218†		

LAND, OR SQUARE MEASURE.

The parts reduced to the decimal of an acre.

Roods.

1= ·25
2= ·5
3= ·75

Rods.

80= ·5
20= ·125
10= ·0625
9= ·05625
8= ·05
7= ·0437†
6= ·0375
5= ·0312†
4= ·025
3= ·0187†
2= ·0125†
1= ·0062†

Yards.

16= ·0033†
15= ·003†
14= ·0028†
13= ·0026†
12= ·0024†
11= ·0022†
10= ·002 †
9= ·0018†
8=·0016†
7=·0014†
6=·0012†
5=·0010†
4=·0008†
3=·0006†
2=·0004†
1=·0002†

BEER MEASURE.

The parts reduced to the decimal of a barrel.

Gallons.

18= ·4992†
10= ·2773†
9= ·2496†
8= ·2219†
7= ·1942†
6= ·1662†
5= ·1388†
4= ·1108†
3= ·0831†
2= ·0554†
1= ·0277†

Quarts.

3= ·0207†
2= ·0138†
1= ·0069†

SOLID MEASURE.

The parts reduced to the decimal of a ton of round timber.

Feet.

20=·5
10=·25
9=·225
8=·2
7=·175
6=·15
5=·125
4=·1
3=·075
2=·05
1=·025

Inches.

1700=·0238†
700=·0098†
100=·0014†
90=·00126†
80=·00112†
70=·00098†
60=·00084†
50=·00070†
40=·00056†
30=·00042†
20=·000280†
10=·000140†
5=·000070†
4=·000056†
3=·000042†
2=·000028†
1=·000014†

WOOD MEASURE.

The parts reduced to the decimal of a cord.

Solid Feet.
100= ·78†
90= ·702†
80= ·624†
70= ·546†
60= ·468†
50= ·39†
40= ·312†
30= ·234†
20= ·156†
10= ·078†
9= ·0702†
8= ·0624†
7= ·0546⸸
6= ·0468⸸
5= ·039†
4= ·0312†
3= ·0234†
2= ·0156†
1= ·0078†

DRY MEASURE.

The parts reduced to the decimal of a bushel.

Pecks.
3= ·75
2= ·5
1= ·25

Quarts.
8= ·25
7= ·2194†
6= ·1882†
5= ·157†

Quarts.
4= ·125
3= ·0936†
2= ·0624†
1= ·0312†

CLOTH MEASURE.

The parts reduced to the decimal of a yard.

Quarters.
3= ·75
2= ·5
1= ·25

Nails.
3= ·1875
2= ·125
1= ·0625

TIME.

Days reduced to the decimal of a year of three hundred sixty-five days.

Days.
100= ·273†
60= ·1638†
50= ·1365†
40= ·1092†
30= ·0819†
20= ·0546†
10= ·0273†
9= ·02457†
8= ·02184†
7= ·01911†
6= ·01638†
5= ·01365†
4= ·01092†
3= ·00819†
2= ·00546†
1= ·00273†

LONG MEASURE.

Links reduced to the decimal of a rod, allowing twenty five to a rod.

Links.	9= ·36	6= ·24	3= ·12
20= ·8	8= ·32	5= ·2	2= ·08
10= ·4	7= ·28	4= ·16	1= ·04

REDUCTION.

Reduction teaches to reduce one denomination to another, retaining the same value. Reduction is called Descending when it is required to reduce a larger to a smaller denomination, and is then performed by multiplication.

Rule. Multiply the highest denomination by such a number, as will reduce it to the next, lower; observing to bring in the next denomination, &c.

REDUCTION DESCENDING.

1. Reduce 444 dollars to mills.

Dolls.
444
100

44400 cts.
10

Ans. 444000 mills.

2. In 57 dollars 93 cents 5 mills how many mills? Ans. $57·93·5

3. In 4 cwt. 2 qrs. 20 lb. how many pounds, Avoirdupois weight? Ans. 524 lb.

4. In 20 acres, 29 rds. how many square rds.? Ans. 3229 rds.

5. How many inches from Exeter to Dover; it being 18 miles? Ans. 1140480 in.

6. How many inches will reach round the world; it being 360 degrees, each degree containing 69½ mile[illegible]

Ans. 1585267200 [illegible]

7. How many solid feet in 20 cords of wood?

Ans. 2560 sd. ft.

8. How many pints are in 1 tun of wine?

Ans. 2016 pts.

9. How many minutes in 33 years, 2 months, 12 days; allowing 13 months to a year, and 4 weeks to a month, and 7 days to a week?

Ans. 289920 m.

10. In 29 yards, 2 quarters, 3 nails, how many nails?

Ans. 475 na.

REDUCTION ASCENDING.

Reduction is called Ascending when is is required to reduce a smaller to a larger denomination; and it is then performed by division.

Rule. Divide the lowest denomination by such a number as will make one of the next higher; and the last quotient by such a number as will make one of the next, &c. until you have reduced it to the denomination required.

1. Reduce 444000 mills to dollars.

10)444000 mills.

10)44400 cts.

10)4440 dimes.

Ans. 444 dollars

2. In 57935 mills how many dollars, &c?

Ans. $57·93 cts. 5 m.

3. In 524 lb. Avoirdupois, how many cwt. &c.?

Ans. 4 cwt. 2 qrs. 20 lb.

4. In 3229 rods; how many acres?

Ans. 20 acres, 29 rods.

5. In 1140480 inches, how many miles?

Ans. 18 miles.

6. In 1585267200 inches how many degrees, each containing 69½ miles ? Ans. 360 deg.

7. How many cords of wood are in 2560 solid feet ? Ans. 20 cords.

8. In 2016 pints of wine, how many tuns. Ans. 1 tun.

9. In 289920 minutes, how many years ; allowing 7 days to a week, 4 weeks to a month, and 13 months to a year ? Ans. 33 years, 2 mo. 12 d.

10. In 475 nails, how many yards ? Ans. 29 yrs. 2 qr. 3 na.

COMPOUND DIVISION.

Compound Division teaches, by having the price of several things given, to find the price of one.

CASE I.

When the quantity is an even number.

Rule.—Divide the price by the quantity, (if there are decimals in the price, point them off according to the rule of division of decimals) the quotient will be the price of one, in dollars and parts.

Examples.

1. If 24 bushels of rye cost $21, how much is 1 bushel of it worth ?

```
     Dolls. Cts.
24)21·000(·875=87 cts. 5 m. Ans.
   192
   ———
    180
    168
    ———
     120
     120
     ———
```

2. If 340 bushels of rye cost $456·25 cts. I demand the price of 1 bushel.

Ans. $1·341$\frac{310}{340}$.

3. If 2020 lb. of cheese cost $180·80 cts.; what does it stand per pound? Ans. $0·09 cts.

CASE II.

When it is to find the price per cwt. and there are parts in the quantity, such as cwt. qr. &c.

Rule.—Reduce the smaller denominations to the decimal of an cwt. (by case 2d in reduction of decimals) then divide the price by the quantity, as in case 1st; the quotient pointed according to the rule of decimals, will be the answer.

Examples.

1. If 2 cwt. 3 qr. of sugar cost $45·26 cts.; I demand the price of 1 cwt.

```
Cwt. qr.   cwt.   D.  cts.
 2   3 = 2·75)45·26($16·458 50/275 Ans.
              275
              ----
              1776
              1650
              ----
               1260
               1100
               ----
                1600
                1375
                ----
                 2250
                 2200
                 ----
                   50
```

2. If 15 cwt. 2 qr. of rice are sold for $54·25 cts.; I demand the price of 1 cwt.

Ans. $3·5 dimes.

3. If 3 cwt. 2 qr. 14 lb. of iron cost $16·67·5; I demand the price per cwt.

Ans. $4·6 dimes.

CASE III.

When several hundreds, and parts, &c. are given to find the price per pound.

Rule.—Find the price per cwt. by case 2d; then divide the price per cwt. by 112; (if gross weight; if neat, by 100) the quotient will be the answer.

Examples.

1. If 3 cwt. 2 qr. 14 lb. of iron cost $16·67 cts. 5 m. I demand the price per pound.

Cwt. gr. lb. cwt. D. c. m. D. d. c. m.

3 2 14=3·625)16·67·5(4·6÷112=·041$\frac{8}{112}$. Ans.

14500

21750

21750

2. If 20 acres, 40 rods of land were sold for $303·75 cts.; I demand the price per acre. Ans. $15.

CASE IV.

To divide by fractional parts, is the same as multiplying by them; see case 5th, compound multiplication.

Examples.

1. What is the value of $\frac{3}{4}$ of an house which is valued at $3000?

3000×3=9000÷4=$2250. Ans.

CASE V.

When the shares are unequal.

Rule.—Divide the sum by the number of simple shares, the quotient will be the share of the first, which, multiply by so many as the second has more than the first, and thus continue till you have found all the shares.

Proof.—Add all the shares together, and if the sum is equal to the sum divided, the work is right.

Examples.

1. Divide $373·50 cts. among A. B. and C. in such a manner that B. may have twice as much as A. and C. twice as much as B.

A. has 1 simple share.
B. " 2 " shares.
C. " 4 " "

7 number of simple shares.

$$\$373{\cdot}50 \div 7 = \$53{\cdot}35\tfrac{5}{7},\ \text{A's.}$$
$$\text{A's, } \$53{\cdot}35\tfrac{5}{7} \times 2 = 106{\cdot}70\tfrac{10}{7},\ \text{B's.}$$
$$\text{B's, } \$106{\cdot}70\tfrac{10}{7} \times 2 = 213{\cdot}40\tfrac{20}{7},\ \text{C's.}$$

PROOF.—$373·50 cts.

2. Divide $1089·83 cents among 4 persons, and give the second, three times as much as the first; the third, four times as much as the second, and the fourth 5 times as much as the third.

$$\left.\begin{array}{r} \$14{\cdot}33\dagger\ \text{A's.} \\ 42{\cdot}99\dagger\ \text{B's.} \\ 171{\cdot}96\dagger\ \text{C's.} \\ 859{\cdot}80\dagger\ \text{D's.} \end{array}\right\}\ \text{Answers.}$$

PROOF,—1089·08 and 25 cts. lost in fractions.

CASE VI.

When the shares are not equal, but increase by a certain ratio, as 1, 2, 3, 4, 5, &c.

RULE.—Divide the sum by the number of persons and the quotient is the share of the middle person, from which, subtract the ratio, and the remainder is the next less; add the ratio to the middle person's share, and the sum is the next largest, &c. When the number of persons is even, divide as before, and subtract half the ratio from the quotient, the remainder is one share, and also add half the ratio to the quotient and the sum is another share; these two shares must be the shares of the two middle persons; from which, continue to subtract and add till you have found all the shares.

Examples.

1. Divide $600 among 5 persons, and as often as A. has 2, give B. 4, C. 6, D. 8, and E. 10 dolls.

$$\$600 \div 5 = \begin{cases} 116 \text{ A's share,} \\ 118 \text{ B's} \quad \text{"} \\ 120 \text{ C's} \quad \text{"} \\ 122 \text{ D's} \quad \text{"} \\ 124 \text{ E's} \quad \text{"} \end{cases}$$

Proof—$600.

2. Divide $640 among 7 persons in such a manner, that the second shall have one more than the first, the third one more than the second, &c.

Ans. A's share, $88·42$\frac{6}{7}$, B's, 89·42$\frac{6}{7}$, C's, 90·42$\frac{6}{7}$, D's, 91·42$\frac{6}{7}$, E's, 92·42$\frac{6}{7}$, F's, 93·42$\frac{6}{7}$, G's, 93·42$\frac{6}{7}$.

3. Divide $1600 among four persons, in such a manner, that as often as the first has one, the second 2, the third 3, the fourth 4 dolls.

$1600 ÷ 4 = 400 middle share.

398·50 A's share.
Middle share { 400—·50 half ratio = 399·50 B's "
Middle share { 400+·50 " " = 400·50 C's "
401·50 D's "

Proof.—1600·00

AVERAGE JUDGMENT.

Average Judgment, is the mean, or middle Judgment, of several persons; it is found thus:

Rule. Add together the several sums which the commodity is appraised at, by the different appraisers, for a dividend; and the number of appraisers for a divisor; divide, and the quotient will be the mean or middle Judgment.

Examples.

1. What is the value of a piece of land, which is valued by A. at $10; by B. at $11·50; by C. at $12·30; and by D. at $13·40 cts. per acre.

A.	1.	-	$10·00
B.	1.	-	11·50
C.	1.	-	12·30
D.	1.	-	13·40
Appraisers 4			4)47·20
			$11·80 Answer

2. A. B. C. D. E. and F. were appointed to appraise a certain estate; they appraised it as follows, viz. A. at $3470; B. at $3650; C. at $3700; D. at $3500; E. at $3400 and F. at $3600; I demand the average judgment.

Ans. $3553·33 cts. 3⅔ m.

3. M. N. O. and P. appraised the ship Lucy as follows, viz. M. at $6700; N. $9000; O. at $8750 and P. at $7380; what is the middle judgment? Ans. $7957·5 dimes.

SINGLE RULE OF THREE DIRECT.

The Single Rule of Three Direct teaches, by having three numbers given, to find a fourth, that shall have the same proportion to the third, as the second has to the first. If more require more, the proportion is direct: if less require less, the proportion is also direct: more requiring more, is when the third term is greater than the first, and the sense of the question requires that the fourth term should be greater than the second: less requiring less, is when the third term is less than the first, and the sense of the question requires that the fourth term should be less than the second.

Rule. State the question, or arrange the three given numbers in such order, that the one which asks the question may stand in the third place; that number which is of the same name with the third, must possess the first place; the remaining number (which is always of the same name with the number required) must possess the middle place. Reduce the first and third terms, or numbers, into the same denomination; and reduce the middle number, or term, into the lowest denomination mentioned: then multiply the 'second and third terms together, and divide the product by the first; the quotient will be the answer, or fourth term sought; and always will be of the same denomination as that of the middle term, when it was multiplied with the third term; and may be reduced to any other denomination required. N. B. The third term is generally preceded by some such words as the following, *viz.* How far? What will? How much? How long? &c.

N. B.—I have wrought the questions, first in decimals, and then in the common way: the learner is advised to do them both ways, then one will prove the other.

1. If 10 sheep are worth $22·22; what are 19 of the kind worth?

Sheep *D. cts.* *sheep.*
As 10 : 22·22 : : 19
19

19998
2222

10)422·18

42·218 = $42·21 cts. 8 m. Ans.

Note. In this question 19 sheep is the number that asks the question, and is placed in the third place; 10 being of the same name, *viz.* sheep, it is placed in the first place, and the remaining number, viz. $22·22 cents, is the number left and must be the middle term; and is of the same name with the number sought, viz. money.

The same question done the common way.

Sheep *D. cts.* *sheep.*
As 10 : 22·22 :: 19
100
2222
19
19998
2222
10)42218
100)4221$\frac{8}{10}$ cts.
\$42·21$\frac{8}{10}$ Answer.

NOTE. In this example the first and third terms are of the same name, they need no reducing; there being cents mentioned in the middle term, I reduce the whole to cents, and the answer comes in cents; which I divide by 100 to bring them into dollars.

2. If 20 acres, 1 rood, 20 rods of land cost \$183 37 cts. 5 m.: what will 37 acres of the same kind be worth?

20 acres, 1 rood, 20 rods = 20·375 acres.

Acres *dols.* *acres.*
As 20·375 : 183·375 :: 37 \$333 Ans.

NOTE. In this example I reduced the 1 rood, 20 rods to the decimal of an acre, and it stands thus, 20 acres ·375. Then I multiply and divide according to the rule of decimals.

The same question done the common way.

Acres rood rds. *D. cts. m.* *acres.*
As 20 1 20 : 183·37·5 :: 37 Ans. \$333.

NOTE. In this example there being rods in the first term, I brought all the first term into rods, and also brought the third term into rods; and the middle term into mills; then multiplied and divided according to rule, the answer came in mills.

3. If 23 cwt. 3 qrs. of sugar is worth $261·25 cts. I demand what must be given for 2 cwt. 1 qr. of the kind. Ans. $24·75 cts.

The same question done the common way.
Ans. $24·75.

4. What will 4 hhd. of rum come to, containing as follows, *viz.* the first 101½, the second 96¾, the third 89¼ and the fourth 111¾, gallons: if 6½ gallons cost $6·89? Ans. $423·20 cts. 5 m.

The same question done the common way.
Ans. $423·20 cts. 5 m.

5. If 1000 feet of boards are worth $11·12 cents; I demand the price of 17221 feet.
Ans. $191·49 cts. 7½ m.

The same question done the common way.
Ans. $191·49·7½ m.

6. If ⅓ of 6 be three; I demand the value of ¼ of 20. Ans. 7·5

The same question done the common way.
Ans. 7½.

7. If 6½ dozen pigeons are worth ·65 cents; I demand the price of 29¾ dozen.
Ans. $2 97 cts. 5 m.

The same question done the common way.
Ans. $2·97·5.

8. If 65 bushels and 1 peck of corn were spent in a family of 6 persons; I demand the quantity that would be sufficient to support a family of 22 persons for the same time. Ans. 239·25 bushels.

The same question done the common way.
Ans. 239¼ bushels.

9. How long will 34261 lbs. of beef last an army of 600 men; allowing them to draw $4\frac{1}{2}$ ounces each, and that 3 times per day? Days $67\frac{5476}{8100}$ Ans.

The same question done the common way.
Ans. $67\frac{5476}{8100}$ days.

10. How many times would a wheel, that is 16 ft. 3 inches in circumference, turn round in going round the world on the Equator; allowing a degree there to contain $69\frac{1}{2}$ miles? Ans. $8129575\frac{625}{1625}$.

The same question done the common way.
Ans. $8129575\frac{75}{195}$.

11. How far are the inhabitants of the equator carried in a minute: allowing the earth to make one revolution in 24 hours: and allowing a degree to contain $69\frac{1}{2}$ miles? Ans. 17 mi. 3 fur.

The same question done the common way.
Ans. 17 mi. 3† fur.

12. A merchant failing in trade, is owing $6420·20 cents; his effects are worth $3142·75 cents; what will A. lose, to whom he owed $960·73 cents?
Ans. $490·44†.

The same question done the common way.
Ans. $490·44† cts.

13. A merchant failing, is owing $7500: his effects amount to $5640; what can he pay per cent?
Ans. $75·2† dimes.

The same question done the common way.
Ans. $75·20† cts.

14. If the earth makes one revolution in one solar day; I demand the time that it is in passing one degree. Ans. 4 minutes.

The same question done the common way.
Ans. 4 minutes.

15. If the sun is 4 minutes in passing one degree; I demand the difference of time of its coming to the meridian, at two places which lie 20 degrees apart.
Ans. 1 hour 20 min.

The same question done the common way.
Ans. 1 hour 20 min.

16. What is the insurance upon 3472 dols. at $3\frac{1}{2}$ per cent? Ans. $121·52 cts.

The same question done the common way.
Ans. $121·52 cts.

17. If half an acre of land is worth $59·20 cents; I demand the price of $1\frac{1}{4}$ acres. Ans. $148.

The same question done the common way.
Ans. $148.

18. I demand the value of $642 against an estate which can pay only ·69 cents on the dollar.
Ans. $442·98 cts.

The same question done the common way.
Ans. $442·98.

19. There is a cistern having 4 cocks; the 1st empties it in 15 minutes; the 2d in 30 minutes; the 3d in 45 minutes, and the 4th in 60 minutes; In what time would it be emptied if they were all running together?

As 15 : 1 :: 120 : 8
30 : 1 :: 120 : 4
45 : 1 :: 120 : $2\frac{2}{3}$
60 : 1 :: 120 : 2

$16\frac{2}{3}$

Cisterns min. cistern min. sec.
As $16\frac{2}{3}$: 120 :: 1 : 7 12 Ans.

METHOD OF MAKING TAXES.

The first thing requisite in making taxes is to know the rate at which polls and rateable estates are valued by the laws of the state. Which, according to the statute in force in New-Hampshire in 1811, were as follows.

N. B. As these rates are established by the Legislature of the state, they are often altered.

The value of Rateable Estates, as valued by the laws of New-Hampshire in 1811.

		cts.
Each poll from 18 to 70 years of age, except those excused by the statute, - at	-	$1·30
HORSES.		
Stallions wintered 3 winters, each	" - -	5·00
Other horse kind wintered 5 winters	" - -	·70
do. do. 4 do.	" - -	·50
do. do. 3 do.	" - -	·30
do. do. 2 do.	" - -	·10
OXEN.		
Oxen five years old, each ox	" - -	·40
do. four years old do.	" - -	·30
COWS.		
Cows wintered 5 winters each	" - -	·20
OTHER NEAT STOCK.		
All neat stock wintered 3 winters	" - -	·10
All neat do. wintered 2 do.	" - -	·05

ORCHARD LAND.

So much orchard as will produce 10 barrels of cider or perry is called an acre; and each acre is valued at - - *cts.* ·30

ARABLE OR TILLAGE LAND.

So much land as will produce 25 bushels of corn, or other grain equivalent, is accounted an acre; and each acre is valued " - - ·20

MOWING LAND.

As much land as will produce 1 ton of English hay yearly, or other hay equivalent is accounted an acre, and each acre is valued " - - ·20

PASTURE LAND.

As much pasture land as will keep 1 cow (one year with an other,) is called 4 acres; and each acre is valued " - - ·05

MILLS, WHARVES AND FERRIES.

These are estimated at $\frac{1}{12}$ of their neat yearly income, after deducting repairs, &c.

BUILDINGS AND UNIMPROVED LANDS

Of inhabitants and non-residents are valued at half of one per cent. of their real value.

STOCK IN TRADE.

Stock in trade at half of one per cent.

BANK SHARES.

All bank shares are valued at $\frac{3}{4}$ of one per cent.

CARRIAGES.

All carriages of pleasure are valued at half of one per cent. of their real value.

MONEY.

Money at interest, or on hand more than the owner pays interest for; is valued at $\frac{3}{4}$ of one per cent.

Having shown the rates at which rateable estates are valued, I shall now proceed to form an Inventory of the estates to be taxed.

INVENTORY.

Persons names.	Polls each at $ 1 30 cts.	Oxen, 5 years old at $ 0·40 cts.	Oxen, 4 years old at $ 0·30 cts.	Cows, 5 years old at $ 0·20 cts.	Cattle, 3 years old at $ 0·10 cts.	Cattle, 2 years old at $ 0·05 cts.			Total amount of rateable estate.
	$1.30	$0.40	$0.30	$0.20	$0.10	$0.5			
A. B.	3	4	2	6	8	8			8.50.
C. D.	1	2	3	4	6	1			4.45.
E. F.	2	3	1	4	2	7			5.45.
G. H.	2			1					2.80.
I. J.	1								1.30.
	9	9	6	15	16	16			22.50.
	9 polls each, at $ 1·30.	9 oxen, five years old, each at $0·40 cts.	6 oxen, four years old, each at $0·30 cts.	15 cows, five years old, each at $0·20 cts.	16 cattle, three years old, each at $0·10 cts.	16 cattle, two years old, each at $0·05 cts.			Total amount of rateable estate . . . .
Proof, $22·50 cts.	11·70	3·60	1·80	3·00	1·60	$0·80 cts.			$22·50 cts.

NOTE. The first column in the inventory is the names of persons; the second column is polls at $ 1 30 cents, it being the rate at which one poll is valued by the statute. In this column write down each mans' number of polls against his name. The third column is marked, oxen, 5 years old, at $ 0 40 cts., it being the rate at which one ox is valued by the statute; In this column write down each mans' number of oxen against his name: thus proceed through all the parcels of estate to be taxed.

N. B. I have for brevity sake omitted several articles of rateable estate in the inventory; those which I have inserted I think will sufficiently explain the method of arranging an inventory.

The method of finding the amount of each mans' rateable estate.

RULE. Multiply each mans' number of polls by the value of one; his number of oxen by the value of one; his number of cows by the value of one; and so of all the parcels of rateable estate; add the products together, the sum is his rateable estate.

Required the rateable estate of A. B. who has

3 Polls	at	$1.30	=	$3·90
4 Oxen five years old	"	·40	=	1·60
2 do. four yrs. old	"	·30	=	60
6 Cows five yrs. old	"	·20	=	1.20
8 Cattle three yrs. old	"	·10	=	·80
8 do. two yrs. old	"	·05	=	·40
Amount of A. B's. rateable estate.				$8·50

Thus proceed to find the amount of rateable estate belonging to each man, and the amounts of their estates will be as follows: A. B's. 8·50: C. D's. 4·45: E. F's. 5·45: G. H's. 2·80 and I. J's. 1·30: which being added together, their sum is $22·50, and is the whole value of the Inventory.

To prove the Inventory.

Rule. Add together the number of polls in the column of polls; multiply the sum by the value of one; the product will be the value of all the polls.

In like manner add every column of the inventory, and multiply the sum of each column by the value of one in that column; add the several products together, and the sum of all the products will be the whole value of the inventory as before.

Examples.

In the preceding inventory I add up the column of polls, the sum is 9, which I multiply by the value of one, *viz.* $1·30 cents, and the product is $11·70: the second column contains 9 oxen at ·40 cts.: the third column contains 6 oxen four years old at ·30 cts.: the fourth contains 15 cows at ·20 cts.: the 5th contains 16 ctl. three years old at ·10 cents: and the sixth contains 16 ctl. two years old, at ·05 cts. each: and the sum of the products of all the columns is $22·50: and is the same as the sum of each man's rateable estate; therefore the work is right.

To make the proportion of tax equal, according to the value of each man's rateable estate.

Rule. Make tables for every separate tax, by making the sum of the inventory the first term: The sum that is to be raised in any one tax, the second term: and one dollar the third term: the number arising from the operation will be what is raised on one dollar of rateable estate: from this, make the table from 1 to 10, 20, or 30 dollars, as you may think necessary.

In the same manner find what is paid on one cent of rateable estate; and from this, make a table from one to 90 cents: and from these tables take each man's tax.

Examples.

Suppose the estates named in the preceding inventory are liable to pay 225 dolls. for the building of a school-house; each man's tax is required, in proportion to his rateable estate.

To find what 1 *dollar pays.*

If $22·50 cts. pay 225 dollars, what will 1 dollar pay ?

D. cts. *D.* *D.*
22·50 : 225 : : 1
1

22·50)225·00(10 dolls. Ans.
2250

0

To find what 1 *cent will pay.*

If $22·50 cts. pay 225 dolls. what will 1 cent pay ?

D. cts. *D.* *ct.*
22·50 : 225 : : ·01
·01

22·50)22500(·10 cts. Ans.
2250

0

Dollar Table, from one dollar to twenty.			
1	- dollar	- pays -	$10
2	“	“	20
3	“	“	30
4	“	“	40
5	“	“	50
6	“	“	60
7	“	“	70
8	“	“	80
9	“	“	90
10	“	“	100
11	“	“	110
12	“	“	120
13	“	“	130
14	“	“	140
15	“	“	150
16	“	“	160
17	“	“	170
18	“	“	180
19	“	“	190
20	“	“	200

Cent Table, from one to ninety cts. inclusive.			*cts.*
1	- cent	- pays	·10
2	“	“	·20
3	“	“	·30
4	“	“	·40
5	“	“	·50
6	“	“	·60
7	“	“	·70
8	“	“	·80
9	“	“	.90
10	“	“	1·00
20	“	“	2·00
30	“	“	3·00
40	“	“	4·00
50	“	“	5·00
60	“	“	6·00
70	“	“	7·00
80	“	“	8·00
90	“	“	9·00

From the above table take A B's tax. His rateable estate is $8·50. By the table $8 pays - $80
" " ·50 " - 5 -

$85 A. B's tax.

In the same manner take each man's tax from the tables, and their proportion will be as follows.

School House Tax.

A. B.	$85·00
C. D.	44·50
E. F.	54·50
G. H.	28·00
I. J.	13·00

$225 tax.

Proof. Add all the taxes together, the sum must be like the sum raised, if the work is right, except what is lost in fractions.

Note. The sum of all their tax is 225 dolls. The same as the sum which was raised; therefore the work is right.

Suppose the estates in the preceding inventory are taxed in a further sum of 19 dollars (the first sum being inadequate to their purpose;) I demand the proportion to each man, according to their several rateable estates.

To find what one dollar pays.

Say if 22 dolls. 50 cents pay 19 dollars; what will 1 dollar pay?

Dolls. cts. *dolls.* *doll.*
As 22·50 : 19 : : 1
1

22·50)19·0000(·84·4† m. Ans.
18000

10000
9000

10000
9000

1000

To find what 1 cent will pay.

Say if 22 dolls. 50 cents pay 19 dollars what will 1 cent pay?

Dolls. cts.		*dolls.*		*ct.*
As 22·50	:	19	: :	·01
		·01		

22·50)·19·000(·00·8† m. Ans.

18000

1000

Dollar Table, from one dollar to eighteen.			
			D. c. m.
1 -	dollar -	pays	0·84·4
2	"	"	1·68·8
3	"	"	2·53·2
4	"	"	3·37·6
5	"	"	4·22·0
6	"	"	5·06·4
7	"	"	5·90·8
8	"	"	6·75·2
9	"	"	7·59·6
10	"	"	8·44·0
11	"	"	9·28·4
12	"	"	10·12·8
13	"	"	10·97·2
14	"	"	11·81·6
15	"	"	12·66·0
16	"	"	13·50·4
17	"	"	14·34·8
18	"	"	15·19·2

Cent Table, from one cent to ninety.			
			cts. m.
1 -	cent -	pays	·00·8
2	"	"	·01·6
3	"	"	·02·4
4	"	"	·03·2
5	"	"	·04
6	"	"	·04·8
7	"	"	·05·6
8	"	"	·06·4
9	"	"	·07·2
10	"	"	·08
20	"	"	·16
30	"	"	·24
40	"	"	·32
50	"	"	·40
60	"	"	·48
70	"	"	·56
80	"	"	·64
90	"	"	·72

From the last tables it is required to take A. B's. tax. His rateable estate is $8·50.

8 dollars pay	$6·75·2
50 Cents pay	·40
	$7·15·2 A. B's. tax.

Proceed in like manner to find the others' taxes, and their several proportions will stand thus:

The second tax.

A. B.	7·15·2
C. D.	3·73·6
E. F.	4·58
G. H.	2·32·8
I. J.	1·08·4

Sum total, $18·88·0

which is twelve cents less, than the sum which ought to be raised; it being lost in the remainders, &c.

Note. In assessing taxes, the law allows the assessors to assess a certain sum, over and above the necessary sum, to be raised: or else the tax would not be large enough, when there are remainders, which is almost always the case.

* * *

INVERSE PROPORTION.

Inverse proportion teaches by having three numbers given to find a fourth that shall have the same proportion to the third, as the first has to the second. When more requires less, the question is Inverse proportion; when less requires more, the question is also Inverse proportion: More requires less, when the third term is larger than the first, and the sense of the question requires the fourth to be less than the second: Less requires more when the third term is smaller than the first; and the sense of the question requires the fourth to be greater than the second.

Rule. Make that number which asks the question the third term; that, which is of the same name, the first term; and the other remaining number must be the middle term: then multiply the first and second terms together, and divide the product by the third; the quotient will be the answer required.

1. If 8 men can build a tower in 12 days; I demand how long it would take them, if 4 more were added.

$$\begin{array}{lccccccccc} & \textit{men} & & \textit{days} & & \textit{men} & & \textit{men} & & \textit{men.} \\ \text{As} & 8 & : & 12 & :: & 12 & + & 4 & = & 16 \\ & & & 8 & & & & & & \end{array}$$

$$16\overline{)96}(6 \text{ days Ans.}$$
$$96$$

Note. In this example it is evident that 16 men would do the work quicker than 8, therefore more requires less; more men, less time, &c.

The same question done the common way.
Ans. 6 days.

2. There is a piece of land 16·5 rods long: I demand the width to make an acre, allowing 20 links to a rod. Ans. 9·696 rds.

The same question done the common way.
Ans. 9 rds. 13† lin.

3. A ship at sea is provided with bread and water sufficient to supply 20 men 9 months, 30 days to a month: but finding a wreck in which were 3 men and 3 boys, to whom they were willing to communicate relief: I demand the time they all can draw their allowance, allowing 2 boys equal to a man.
Ans. 7·346 mo.

The same question done the common way.
Ans. 7 months 10† days.

4. There is a piece of land that is 10 rds. 10 links in width; I demand the length to make an acre, allowing 20 links to a rod. Ans. 15·238 rds.

The same question done the common way.
Ans. 15 rds. 4† links.

5. How much in length, of that which is 5 rods wide, will make an acre?
Ans. 32 rds.

The same question done the common way.
Ans. 32 rds.

6. How much carpeting, that is 1·5 yds. wide, will cover a floor that is 7·5 yds. long, and 5 yds. wide?

Ans. 25 yds.

The same question done the common way.

Ans. 25 yds.

DOUBLE RULE OF THREE.

The Double Rule of Three teaches to solve such questions as require two statings in the Single Rule of Three: five numbers are given to find the sixth. State the question by placing that number, which is the principal cause of gain or loss, in the first place: that number which represents time, distance, &c. (that the first is gaining or losing) in the second place; that number, which represents the gain or loss, in the third place: then place the other two numbers under those of the same name; and if the term sought, or the blank place, fall under the third place; then multiply the three last terms together for a dividend, and the other two, for a divisor: but if the blank place fall under the first or second place, then multiply the first, second and last terms together for a dividend, and the other two for a divisor.

Note. The 6th term or answer always will come of the same name, and of the same denomination, of the term directly over the blank place.

Having given a rule to solve questions in the Double Rule of Three by one stating, I now proceed to give a rule to solve the same questions by two statings in the Single Rule of Three.

Rule. Make the number which is the principal cause of gain, or loss the first term: the gain or loss the second: the number, which is the demand of the question the third: the answer to this first statement will show what the third term gained, or lost, in a time that the first term was gaining or losing, (which time is always mentioned in the question) therefore say in the second stating, as the space of time, or distance, &c. mentioned in the question, is to the answer of the first statement, so is the required time or distance, &c. to the answer.

Questions done by one, then by two statements.

1. If 200 dollars in 12 months will gain 12 dollars; I demand how many 50 dollars will gain in 6 months.

dolls. *mo.* *dolls.*
200 : 12 :: 12
50 : 6 ::

Three last terms 50×6×12=3600.
Two first terms 200×12=2400.
3600÷2400=$1,50 Ans.

The same question done by two statements.

Dolls. *dolls.* *dolls.* *dolls.*
As 200 : 12 :: 50 : 3

Months *dolls.* *months* *doll. cts.*
As 12 : 3 :: 6 : 1·50 Ans.

2. If 4 men spend 60 dollars, going 300 miles; I demand what is sufficient for the expense of 20 men, and one boy 700 miles, allowing the boy one half a man's expense. Ans. $717·50

The same question done by two statements.

men *dolls.* *men* *dolls.*
As 4 : 60 :: 20·5 : 307·5

miles *dolls.* *miles* *dolls.*
As 300 : 307·5 :: 700 : 717·5 Ans.

3. If 3 men can build 360 rods of wall in 24 days; I demand how many rods 7 men would build in 27 days. Ans. 945 rds.

The same question done by two statements.

men *rods* *men* *rods.*
As 3 : 360 :: 7 : 840

days *rods* *days* *rods*
As 24 : 840 :: 27 : 945 Ans.

4. If 3 men in 24 days can build 360 rods of wall; I demand the number of men necessary to build 945 rods in 27 days. Ans. 7 men.

The same question done by two statements. Ans. 7 men.

5. If 50 men can build a bridge in 144 days ; I demand the number of men necessary to build a like bridge in 720 days. Ans. 10 men.

The same question done by two statements.

days *bridge* *days* *bridges*
As 144 : 1 :: 720 : 5
bridges *men* *bridge* *men*
As 5 : 50 :: 1 : 10 Ans.

6. A man lent a friend 600 dollars, for 6 months, for which he received 9 dollars interest : I demand the sum that will gain the same interest in 2 months. Ans. $1800.

The same question done by two statements.

mo. *dolls.* *mo.* *dolls.*
As 6 : 9 :: 2 : 3
dolls. *dolls.* *dolls.* *dolls.*
As 3 : 600 :: 9 : 1800 Ans.

7. A. received of B. for the loan of 600 dollars six months, 9 dollars : now B. wishes to hire of A. 1800 dollars until the loan shall amount to 9 dollars ; how long may he keep it? Ans. 2 months.

The same question done by two statements.

dolls. *interest* *dolls.* *interest.*
As 600 : 9 :: 1800 : 27
dolls. *mo.* *dolls.* *mo.*
As 27 : 6 :: 9 : 2 Ans.

VULGAR FRACTIONS.

Vulgar Fractions are parts of whole numbers, and are expressed thus, $\frac{1}{10}$, $\frac{6}{7}$, &c. The top figure is a remainder left after division, and is called the numerator ; the bottom figure is the divisor used in division, and is called the denominator. Fractions are read thus, $\frac{1}{10}$ is read one tenth ; and $\frac{6}{7}$ is read six sevenths, &c.

Fractions are proper, improper, compound or mixed. A Proper Fraction has its numerator the smallest. An Improper Fraction has its numerator equal, or the largest. A Compound Fraction is the fraction of a fraction, and is coupled by the word *of*. A mixed number is a whole number and fraction.

A proper faction is written thus, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{7}{8}$, $\frac{9}{12}$, &c.

An improper fraction is written thus, $\frac{7}{4}$, $\frac{4}{2}$, or $\frac{5}{5}$, $\frac{6}{6}$. &c.

A compound fraction is written thus, $\frac{1}{2}$ of $\frac{7}{8}$ of $\frac{1}{2}$ of $\frac{6}{4}$.

A mixed number is written thus, $12\frac{3}{4}$, $6\frac{9}{10}$, $5\frac{4}{5}$, &c.

CASE I.

To find the greatest common measure, or that number that will divide the numerator and denominator, without a remainder, and thereby reduce the fraction to its lowest terms.

Rule. Divide the denominator by the numerator, and the last divisor by the last remainder; the last divisor used is the common measure.

N. B. If 1 is the last divisor, the fraction is in its lowest terms.

Examples.

1. What is the greatest common measure of $\frac{322}{464}$?

```
322)464(1
    322
    ---
    142)322(2
        284
        ---
         38)142(3
            114
            ---
             28)38(1
                28
                --
                10)28(2
                   20
                   --
                    8)10(1
                       8
                       -
                       2)8(4
                         8
                         -
```

The common measure is 2.

Therefore $\frac{2)322}{2)464} = \left.\frac{161}{232}\right\}$ The same fraction in its lowest terms.

2. Find the greatest common measure of $\frac{64}{460}$, and by it reduce the fraction to its lowest terms.

The common measure is 4. $\frac{64 \div 4}{460 \div 4} = \frac{16}{115}$ *Ans.*

CASE II.

To reduce a mixed number to an improper fraction.

Rule. Multiply the whole number by the denominator of the fraction, to the product add the numerator of the fraction, and it is done.

Examples.

1. Reduce $10\frac{3}{4}$ to an improper fraction.

$10 \times 4 = 40 + 3 = 43$ numerator, $\frac{43}{4}$ *Ans.*

2. Reduce $112\frac{1}{3}$ to an improper fraction.

$112 \times 3 + 1 = \frac{337}{3}$ *Ans.*

3. Reduce $28\frac{9}{10}$ to an improper fraction.

Ans. $\frac{289}{10}$

CASE III.

To reduce an improper fraction to its proper terms.

Rule. Divide the numerator by the denominator, the quotient is the whole number: the remainder is the numerator of the fraction.

Examples.

1. Reduce $\frac{43}{4}$ to its proper terms.

Ans. $43 \div 4 = 10\frac{3}{4}$.

2. Reduce $\frac{337}{3}$ to its proper terms.

Ans. $112\frac{1}{3}$.

3. Reduce $\frac{289}{10}$ to its proper terms.

Ans. $28\frac{9}{10}$.

CASE IV.

To find the least common denominator.

Rule. Divide the denominators by any number that will divide two, or more of them without a remainder: then divide the undivided numbers and last quotients, by any number that will divide two or more of them, without a remainder: and thus continue dividing till no two numbers can be divided without a remainder; then multiply the divisors and remainders together, the product is the common denominator required.

Examples.

1. What is the least common denominator of $\frac{4}{6}$, $\frac{1}{8}$, $\frac{4}{7}$, $\frac{3}{10}$, and $\frac{9}{18}$?

The denom.

$$\begin{array}{r|ccccc} 3 & 6 & 8 & 7 & 10 & 18 \\ \hline 2 & 2 & 8 & 7 & 10 & 6 \\ \hline & \multicolumn{5}{l}{1\times4\times7\times5\times3\times3\times2} \end{array} \quad \overset{\textit{Com. Denom.}}{2520} \quad \textit{Ans.}$$

2. What is the common denominator of $\frac{3}{9}$, $\frac{6}{14}$, $\frac{4}{8}$, $\frac{12}{16}$, and $\frac{5}{4}$? *Ans.* 1008.

CASE V.

To reduce fractions to common denominators.

Rule. Find the common denominator by case 4th, and use it as a dividend; use each separate denominator as a divisor; multiply the quotients by their respective numerators, and the products placed over the common denominator will form the fractions required.

Examples.

Reduce $\frac{3}{4}$, $\frac{2}{5}$, $\frac{7}{8}$ and $\frac{9}{10}$ to common denominators.

Denominators of the fraction.

$$\begin{array}{r|cccc} 2 & 4 & 5 & 8 & 10 \\ \hline 5 & 2 & 5 & 4 & 5 \\ \hline 2 & 2 & 1 & 4 & 1 \\ \hline & \multicolumn{4}{l}{1\times1\times2\times1\times2\times5\times2=40 \text{ com. den.}} \end{array}$$

$40\div4=10\times3=30$ 1st numerator.
$40\div5=8\times2=16$ 2d numerator.
$40\div8=5\times7=35$ 3d numerator.
$40\div10=4\times9=36$ 4th numerator.

The new numerators being written over the common denominator, the fractions appear thus $\frac{30}{40}$, $\frac{16}{40}$, $\frac{35}{40}$, $\frac{36}{40}$ *Answers*.

2. Reduce $\frac{2}{6}$, $\frac{8}{10}$, $\frac{6}{14}$, $\frac{8}{16}$ and $\frac{4}{6}$ to common denominators.

Ans. $\frac{560}{1680}$, $\frac{1344}{1680}$, $\frac{720}{1680}$, $\frac{840}{1680}$, $\frac{1120}{1680}$.

3. Reduce $\frac{4}{6}$, $\frac{8}{10}$, $\frac{9}{12}$ and $\frac{11}{14}$ to common denominators.

Ans. $\frac{280}{420}$, $\frac{336}{420}$, $\frac{315}{420}$, $\frac{330}{420}$.

CASE VI.

To reduce compound fractions to simple ones.

Rule. Multiply all the numerators together for a new numerator; and all the denominators together for a new denominator, and it is done.

Examples.

1. Reduce $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{4}{7}$ of $\frac{6}{8}$ to a simple fraction.

$$\begin{array}{ll} \text{Numerators} & \frac{1}{2} \times \frac{3}{4} \times \frac{5}{6} \times \frac{4}{7} \times \frac{6}{8} = \frac{360}{2688} \text{ Ans.} \\ \text{Denominators} & \end{array}$$

2. Reduce $\frac{9}{10}$ of $\frac{1}{2}$ of $\frac{3}{6}$ of $\frac{1}{12}$ of $\frac{2}{10}$ to a simple fraction. Ans. $\frac{27}{1600}$.

CASE VII.

To reduce a fraction of a lower denomination to the fraction of a higher, and retain the same value.

Rule. Reduce the fraction to a compound one, by comparing it with all the denominations between itself, and the denomination, to which you would reduce it: then reduce it to a simple one by the last case.

Examples.

1. Reduce $\frac{3}{10}$ of a mill, to the fraction of a doll.

By comparing it, it becomes $\frac{3}{10}$ of $\frac{1}{10}$ of $\frac{1}{10}$ of $\frac{1}{10}$ = $\frac{3}{10000}$ *Ans.*

2. Reduce $\frac{1}{2}$ of a grain to the fraction of a pound Troy weight.

$\frac{1}{2}$ of $\frac{1}{24}$ of $\frac{1}{20}$ of $\frac{1}{12}$ of $\frac{1}{1}$ $=\frac{1}{11520}$ Ans.

3. Reduce $\frac{3}{4}$ of a day to the fraction of a year, containing 365 days. Ans. $\frac{3}{1460}$.

Note. The above questions may be done by reducing the whole number to the same denomination with the denominator of the fraction, which must be used for the denominator: over which, place the numerator of the given fraction; and it is the fraction required.

Examples.

1. Reduce $\frac{3}{10}$ of a mill, to the fraction of a dollar.

1 doll.
10
—
10 dimes.
10
—
100 cts.
10
—
1000 mills.
10
—

Denom. 10000 tenths of a mill. Ans. $\frac{3}{10000}$.

2. Reduce $\frac{3}{4}$ of a day to the fraction of a year.

1 year.
365
—
365 days.
4
—
1460 fourths of a day. *Ans.* $\frac{3}{1460}$.

CASE VIII.

To reduce the fraction of a higher, to the fraction of a lower denomination, retaining the same value.

Rule. Multiply the numerator of the given fraction, into the denominators of the compound ones between itself and the denomination to which you would reduce it, for a new numerator; which being placed over the given denominator, will form the fraction required.

Examples.

1. Reduce $\frac{3}{10000}$ of a dollar, to the fraction of a mill. $\frac{3}{10000}$ of $\frac{1}{1}$ of $\frac{1}{10}$ of $\frac{1}{10}$ of $\frac{1}{10}$.

$$3\times10\times10\times10=\frac{3000}{\text{given denom. }10000}=\frac{3}{10}\ \text{Ans.}$$

N. B. Invert the denominations between, and multiply the numerators for a new one, and the denominators for a new one, and it is done.

2. Reduce $\frac{3}{1460}$ of a year, to the fraction of a day. $\frac{3}{1460}$ of $\frac{1}{1}$ of $\frac{1}{365}$ which invert $\frac{365\times1\times3}{1\times1\times1460}=\frac{1095}{1460}=\frac{3}{4}$ [*Ans.*

CASE IX.

To express the value of a fraction in the parts of the Integer.

Rule. Multiply the numerator of the fraction into the known denominations of the Integer, and divide the product by the denominator, the quotient is the value of the fraction.

Examples.

1. What is the value of $\frac{9}{10}$ of a dollar.

1 doll. is = 100 cts.

$$\begin{array}{r} 9 \\ \hline 10)900 \\ \hline \cdot90 \text{ cts. } \textit{Ans.} \end{array}$$

2. What is the value of $\frac{4}{6}$ of an cwt. avoirdupois?

Ans. 2 qr. 18 lb. 10 oz. $10\frac{4}{6}$ dr.

3. What is the value of $\frac{9}{12}$ of a cord of wood?

Ans. 96 solid feet.

4. What is the value of $\frac{9}{10}$ of a yard?

Ans. 3 qr. $2\frac{4}{10}$ na.

CASE X.

To reduce parts of an Integer which are expressed in several denominations to the fraction of a greater of the same kind.

Rule. Reduce the several denominations to the lowest denomination mentioned, for a numerator; and reduce the integer to the same denomination for a denominator.

Examples.

1. Reduce 1 d. 9 cts. to the fraction of an eagle.

1 dime 9 cts.$=$19 cts. numerator. 1 Eagle $\times 10 \times 10 \times 10 =$ 1000 cts. denominator.

$\frac{19}{1000}$ *Ans.*

2. Reduce 2 rods, 12 feet to the fraction of a mile.

Ans. $\frac{3}{352}$

3. Reduce 10 feet 100 inches to the fraction of a cord.

Ans. $\frac{17380}{221184}$.

ADDITION OF VULGAR FRACTIONS.

CASE I.

To add fractions having common denominators.

Rule. Add the numerators all together, divide the sum by the common denominator, the quotient is the whole numbers, and the remainder is parts, which must be placed over the common denominator.

Examples.

1. Add together $\frac{9}{15}$, $\frac{10}{15}$, $\frac{6}{15}$, $\frac{5}{15}$, $\frac{11}{15}$, $\frac{12}{15}$, and $\frac{14}{15}$.

The numerators 9+10+6+5+11+12+14=67.

67÷15=$4\frac{7}{15}$ *Ans.*

CASE II:

To add fractions having different denominators.

Rule. Reduce the fractions to common denominators by case 4th, (in Reduction,) use the common denominator as a dividend; use each denominator as a divisor; divide, and multiply the quotients by the several numerators, and the sum of all the products is the numerator to the common denominator, and is the fraction required.

Examples.

1. Add $\frac{1}{2}$, $\frac{3}{5}$, $\frac{4}{6}$, $\frac{6}{8}$, $\frac{8}{10}$, $\frac{10}{12}$, and $\frac{12}{14}$ together.

3	2	5	6	8	10	12	14	denominators.
2	2	5	2	8	10	4	14	
5	1	5	1	4	5	2	7	
2	1	1	1	4	1	2	7	

1×1×1×2×1×1×7×3×2×5×2=840 *com. denom.*

Denom. *Nume.*

840÷ 2=420× 1=420

840÷ 5=168× 3=504

840÷ 6=140× 4=560

840÷ 8=105× 6=630

840÷10= 84× 8=672

840÷12= 70×10=700

840÷14= 60×12=720

4206 numerator. $\frac{4206}{840}$ Ans.

2. Add $\frac{9}{10}$, $\frac{6}{8}$ and $\frac{12}{14}$ together.

Ans. $\frac{1404}{560} = 2\frac{284}{560}$.

3. Add $\frac{3}{4}$, $\frac{6}{7}$, $\frac{8}{9}$, $\frac{10}{11}$ and $\frac{11}{12}$ together.

Ans. $\frac{11980}{2772} = 4\frac{1892}{2772}$.

CASE III.

To add mixed numbers whose fractions have common denominators.

Rule. Add the fractions as in case 1st, and the whole numbers as in Simple Addition; then add the sum of the fractions to the whole number.

1. Add $104\frac{2}{20}$, $111\frac{16}{20}$, $96\frac{14}{20}$ and $80\frac{16}{20}$ together.

Whole numb.	*Fractions.*
104	2
111	16
96	14
80	16
$2\frac{8}{20}$ sum of the fractions.	—
—	$48 \div 20 = 2\frac{8}{20}$
$393\frac{8}{20}$ Ans.	

2. Add $14\frac{6}{13}$, $15\frac{2}{13}$, $18\frac{9}{13}$, and $7\frac{10}{13}$ together.

Ans. $56\frac{1}{13}$.

CASE IV.

To add mixed numbers whose fractions have different denominators.

Rule. Add the fractions as in case second, and the whole numbers as in simple addition: then add the sum of the fractions, to the sum of the whole numbers, and it is done.

Examples.

1. Add $12\frac{1}{2}$, $16\frac{2}{5}$, $17\frac{6}{8}$, $16\frac{10}{12}$, and $19\frac{7}{8}$ together.

Denominators.

$$\begin{array}{r|lllll} 2 & 2 & 5 & 8 & 12 & 8 \\ \hline 4 & 1 & 5 & 4 & 6 & 4 \\ \hline & \multicolumn{5}{l}{1\times5\times1\times6\times1\times2\times4=240} \end{array}$$

com. denominator.

$$\begin{array}{l} 240\div2=120\times1=120 \\ 240\div5=48\times2=96 \\ 240\div8=30\times6=180 \\ 240\div12=20\times10=200 \\ 240\div8=30\times7=210 \\ \hline \end{array}$$

$$806\div240=3\frac{86}{240}.$$

Whole num. $12+16+17+16+19+3\frac{86}{240}=83\frac{86}{240}$ [*Ans.*

2. Add $21\frac{9}{10}$, $6\frac{7}{8}$, $127\frac{1}{2}$, and $14121\frac{1}{3}$ together.

Ans. $14272\frac{73}{120}$.

CASE V.

To add fractions of several denominations, such as parts of cwts.; parts of qrs.; parts of lbs. &c.

Rule. Find the value of each separate fraction by case ninth in reduction, and add the several sums together as in compound addition.

Examples.

1. Add $\frac{1}{2}$ a cwt. $\frac{3}{4}$ of a qr. and $\frac{5}{6}$ of a lb. together.

		qr.	*lb.*	*oz.*	*dr.*
$\frac{1}{2}$ of a cwt. is	=	2	0	0	0
$\frac{3}{4}$ of a qr. is	=	0	21	0	0
$\frac{5}{6}$ of a lb. is	=	0	00	13	$5\frac{2}{6}$
		2	21	13	$5\frac{2}{6}$ *Ans.*

SUBTRACTION OF VULGAR FRACTIONS.

CASE I.

To subtract simple fractions having common denominators.

Rule. Subtract the least numerator from the largest, and the remainder placed over the common denominator will be the difference required.

Examples.

1. What is the difference between $\frac{12}{19}$ and $\frac{10}{19}$?

$$\begin{array}{ll} \text{largest numerator} & 12 \\ \text{smallest numerator} & \underline{10} \\ & 2 \text{ difference } = \frac{2}{19} \textit{ Ans.} \end{array}$$

2. What is the difference between $\frac{22}{41}$ and $\frac{15}{41}$?

Ans. $\frac{7}{41}$

3. What is the difference between $\frac{96}{212}$ and $\frac{74}{212}$?

Ans. $\frac{22}{212}$.

CASE II.

To subtract a simple fraction, or a mixed number, from a whole number.

Rule. Subtract the numerator of the fraction from its denominator, and put the denominator of the fraction under the remainder; and carry one to be deducted from the whole number.

Examples.

1. Subtract $\frac{3}{5}$ from 12.

$$\begin{array}{r} 12 \\ \underline{\frac{3}{5}} \\ 11\frac{2}{5} \textit{ Ans.} \end{array}$$

2. Subtract $27\frac{48}{97}$ from 32. *Ans.* $4\frac{49}{97}$

3. Subtract $12\frac{9}{10}$ from 21.

$$\begin{array}{r} 21 \\ 12\frac{9}{10} \\ \hline 8\frac{1}{10} \end{array} \text{ Ans.}$$

4. From 101 take $100\frac{99}{100}$.

Ans. $\frac{1}{100}$.

CASE III.

To subtract fractions having different denominators.

Rule. Find the common denominator by case 4th in Reduction, and use it as a dividend: and use each given denominator as a divisor; divide, and multiply the quotients by the given numerators; then subtract the least from the greatest, the remainder is the difference required and must be put over the common denominator.

Examples.

1. From $\frac{19}{20}$ take $\frac{22}{45}$.

denominators.

5)20 45

$4 \times 9 \times 5 = 180$ com. denom.

$180 \div 20 = 9 \times 19 = 171$

$180 \div 45 = 4 \times 22 = 88$

$\frac{83}{180}$ Ans.

2. What is the difference between $\frac{11}{15}$ and $\frac{9}{10}$?

$\frac{5}{30} = \frac{1}{6}$ Ans.

CASE IV.

To distinguish the largest of any two fractions, &c.

Rule. Reduce them to a common denominator, (by case 5th in Reduction), and the one that has the largest numerator is the largest fraction.

Example.

1. Which is the greatest fraction $\frac{9}{10}$ or $\frac{11}{12}$?

denominators.

2)10 12

5 × 6 × 2 = 60 com. denom.

$60 \div 10 = 6 \times 9 = 54$

$60 \div 12 = 5 \times 11 = 55$

1 dif.

$\frac{9}{10} = \frac{54}{60}$ and $\frac{11}{12} = \frac{55}{60}$ therefore $\frac{11}{12}$ is the largest by $\frac{1}{60}$

CASE V.

To subtract a mixed number from a mixed number, when the fraction which is to be subtracted is greater than the one which it is to be taken from.

Rule. Reduce the fractions to a common denominator, use it for a dividend, and use the given denominators as divisors, divide, multiply the quotients by the numerators, and the products will be new numerators: then subtract the numerator of the greater from the common denominator, and to the remainder add the lesser numerator: and the sum of them must be set over the common denominator; and carry one to the whole number, and subtract the whole number as in simple subtraction.

Examples.

1. It is required to take $8\frac{12}{19}$ from $12\frac{3}{6}$.

denominators *com. denom.* $114 \div 19 = 6 \times 12 = 72$

$19 \times 6 \times 1 = 114$ $114 \div 6 = 19 \times 3 = 57$

Thus, $\frac{12}{19} = \frac{72}{114}$ and $\frac{3}{6} = \frac{57}{114}$.

72 the greatest numerator subtracted from 114 leaves 42 remainder, to which I add the least numerator, *viz.* $57+42=\frac{99}{114}$, and carry one to 8 and subtract it from 12 the remainder is 3 : thus the difference is $3\frac{99}{114}$ *Ans.*

2. It is required to take $9\frac{16}{18}$ from $10\frac{1}{2}$.
Ans. $\frac{11}{18}$.

3. It is required to take $1\frac{7}{12}$ from $10\frac{3}{10}$.
Ans. $8\frac{43}{60}$.

CASE VI.

To subtract when the fractions are of different denominations; such as parts of cwt. qr. lb. &c.

RULE. Find the value of the fraction (by case 9th in Reduction), then subtract as in compound subtraction. If fractions happen in finding the value of the parts, reduce them to common denominators and subtract as in case third.

Examples.

1. It is required to take $\frac{9}{10}$ of a cwt. from $\frac{6}{8}$ of a ton.

	cwt.	*qr.*	*lb.*	*oz.*	*dr.*
$\frac{6}{8}$ of a ton=	15	0	0	0	0
$\frac{9}{10}$ of a cwt.=	0	3	16	12	$12\frac{8}{10}$
	14	0	11	3	$3\frac{2}{10}$ Ans.

2. It is required to take $\frac{6}{18}$ of a cwt. from $12\frac{1}{2}$ cwt. Ans. 12 cwt. 0 qrs. 18 lb. 10 oz. $10\frac{13}{18}$rd.

MULTIPLICATION OF VULGAR FRACTIONS.

CASE I.

Rule. Reduce compound fractions to simple ones; mixed numbers to improper fractions; then multiply the numerators all together for a new numerator, and the denominators together for a new denominator.

Examples.

1. It is required to multiply $\frac{3}{8}$ by $\frac{2}{16}$ of $\frac{5}{6}$ of $\frac{1}{4}$.

$\frac{2}{16}$ of $\frac{5}{6}$ of $\frac{1}{4} = \frac{10}{384} \times \frac{3}{8} = \frac{30}{3072} = \frac{5}{512}$ *Ans.*

2. It is required to multiply $2\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{6}{8}$.

Ans. $\frac{66}{64} = 1\frac{2}{64}$

3. It is required to multiply $\frac{5}{12}$ by $\frac{9}{10}$.

Ans. $\frac{45}{120} = \frac{3}{8}$

4. Multiply $\frac{1}{2}$ by $\frac{1}{3}$. Ans. $\frac{1}{6}$

DIVISION OF VULGAR FRACTIONS.

Rule. Reduce compound fractions to simple ones, mixed numbers to improper fractions, then invert the divisor (that is put the numerator for the denominator) and multiply the numerators together for a new numerator, and the denominators together for a new denominator; and the fraction thus found is the quotient required.

Examples.

1. Divide $\frac{1}{3}$ by $\frac{6}{8}$.

$\frac{6}{8}$ inverted is $\frac{8}{6} \times \frac{1}{3} = \frac{8}{18} = \frac{4}{9}$ *Ans.*

2. It is required to divide $\frac{5}{1}$ by $\frac{7}{10}$.

$\frac{7}{10}$ inverted is $= \frac{10}{7} \times \frac{5}{1} = \frac{50}{7} = 7\frac{1}{7}$ *Ans.*

3. It is required to divide 10 by $\frac{1}{2}$ of $\frac{3}{5}$.

Ans. $33\frac{1}{3}$.

4. It is required to divide $10\frac{6}{7}$ by $7\frac{3}{10}$.

Ans. $1\frac{249}{511}$.

MISCELLANEOUS QUESTIONS IN VULGAR FRACTIONS.

1. A schoolmaster being asked one day how many scholars he had, made answer that $\frac{1}{5}$ of them sat on one seat, $\frac{1}{10}$ on another, $\frac{2}{5}$ on another, $\frac{2}{10}$ on another, and 6 on another: I demand the number his school consisted of.

$$\frac{1}{5}+\frac{1}{10}+\frac{2}{5}+\frac{2}{10}=\frac{9}{10} \quad 10-9=1=\frac{10}{1} \text{ of } \frac{9}{10} \text{ of } \frac{6}{1}=$$

$$\frac{540}{10}=54+6=60 \text{ Ans.}$$

2. A man, having returned from a journey, was asked by a friend, what his expences were; the answer was, that he spent in Boston $\frac{2}{5}$ of his money: between Boston and New York $\frac{1}{5}$: in New York $\frac{1}{10}$: beyond New York $\frac{1}{20}$, and he brought home $40: I demand the sum he carried, and also what he spent.

Ans. $160 carried.
120 spent.

RULE OF THREE IN VULGAR FRACTIONS.

Rule. State the question as in the Rule of Three Direct, (or Inverse Proportion, according to the nature of the question) and then invert the divisor, and multiply the numerators together, and the denominators together, and the fraction thus found is the fourth term or answer.

Examples.

1. If $\frac{1}{2}$ bushel of corn cost $\frac{75}{100}$ of a dollar, what will $\frac{3}{4}$ of a bushel come to?

$$\text{As } \frac{1}{2} : \frac{75}{100} :: \frac{3}{4} \qquad \text{D.}$$

$$\frac{1}{2} \text{ inverted is} = \frac{2}{1} \times \frac{75}{100} \times \frac{3}{4} = \frac{450}{400} = 1\frac{1}{8} \textit{ Ans.}$$

2. If $10\frac{1}{4}$ bushels of potatoes cost $\$3\frac{1}{4}$; how many may be had for $\$12\frac{1}{2}$?

Ans. $\frac{4100}{104} = 39\frac{44}{104}$.

3. If $\frac{1}{4}$ of $\frac{7}{8}$ of a ship is worth $\frac{5}{8}$ of 16000 dollars; how much is $\frac{1}{2}$ of $\frac{1}{5}$ of her worth?

Ans. $ 4571·42·8$\frac{36}{87}$.

SIMPLE INTEREST.

Interest is a premium paid to the lender by the borrower, for the use of money lent. Simple Interest is reckoned at 6 per cent. that is, at the rate of 6 dolls. for the use of 100 dolls. one year; and so in proportion for a longer, or shorter time, or for a smaller, or larger sum.

Principal is the money lent.

Rate per cent. is the price agreed on.

The amount is the principal and interest together.

CASE I.

The principal and rate given to find the Interest for one year, or more, &c.

Rule. Multiply the principal by the rate per cent. and that product by the number of years: the last product pointed, according to the rule of decimals, will be the answer for that time, in dollars and parts of dollars.

Examples.

1. What is the interest of $22.16 cents for one year, at 6 per cent. per annum?

D. cts.
22·16 principal.
·06 rate per cent.

1·3296
1 time

$1·3296 = $1·32·96 Answer.

Note. 6 per cent. is = ·06 of a dol. or 6 cents on the dollar, and 7 per cent. would be ·07, &c.

2. What is the interest of $223·14 cts. for 5 years, at 6 per cent. per annum?

Time. *D.*
$223·14 × ·06 = 13·38·84 × 5 = 66·94·2† Ans.

3. What is the interest of 123 dol. 10 cts. 1 mill, for 7 years, at 9 per cent. per annum?

Ans. $77·55·3†

CASE II.

When the amount is required.

Rule. Find the interest as in case first, and to it add the principal, the sum is the amount.

1. What will $10·15 cts. amount to in 12 years, at 6 per cent. per annum?

$10·15
·06

·6090
12

7·3080 interest.
10·15 principal added.

Ans. $17·4580 amount.

2. What is the amount of $1·12 cts. for 12 years, at 12 per cent. per annum?

Ans. $2·73·2†.

3. What is the amount of $242·17 cts. for 3 years, at 9 per cent. per annum? Ans. $307·55·5.†

CASE III.

When there are years, months and days in the time.

Rule 1st. Reduce the days and months to the decimal of a year, then multiply the principal, rate, and time together, the product pointed for decimals according to rule will be the answer.

Rule 2d. Find the interest for one year by case first, then for the months, take the aliquot parts of the year: and for the days take parts of a month, add all the parts together, the sum will be the answer.

Examples by rule 1st, and then by rule 2d.

1. What is the interest of $6·22 cts. for 2 years 6 months 10 days, at 6 per cent. per annum?

years mo. days years D. cts. cts. m.
2 6 10 = 2·527 × 6·22 × ·06 = 94·3.† Ans.

The same question by rule 2d.

$6·22 principal.
·06 rate.

months.
6 = $\frac{1}{2}$ of a year. $\frac{1}{2}$)·3732 1 year's interest.
2
·7464 2 year's interest.
·1866 6 month's interest.
·0103† 10 day's interest.
·94·3† interest for 2 yr. 6 mo. 10 ds.

2. What is the interest of $10·10 cts. for 10 years, 11 months, at 9 per cent.?

years. mths. years. D. c. c. c. m.
10 : 11 = 10·916 × 10·10 × ·09 = $9·92·2† Ans.

The same question, by rule 2d.

dolls. cts.
10·10
·09

months.
6 = $\frac{1}{2}$ of 1 year. $\frac{1}{2}$)·9090 1 year's interest.
10
9·0900 10 " "
3 = $\frac{1}{2}$ of 6 mo. $\frac{1}{2}$)0·4545 6 months' "
2 = $\frac{1}{3}$ of 6 " $\frac{1}{3}$)0·2277†
0·1515

$9·9237† *D. c. m.* Ans. 9·92·3.†

3. What is the interest of $213·23 cts. for 3 years, 12 days, at 10 per cent. ? Ans. $64·67 cts. ·9†m.

The same question, by rule 2d.

Ans. $64·67 cts. 9† m.

4. What is the interest of $23·23 cts. for 1 year 9 mo. at 6 per cent. ? Ans. $2·43 cts. 9† m.

The same question, by rule 2d.

Ans. $2·43 cts. 9 m.

5. What is the interest of $121·11 cts. for 2 years, 7 mo. at 5 per cent. ? Ans. $15·64 cts. 3† m.

The same question, by rule 2d.

Ans. $15·64 cts. 3† m.

CASE IV.

Thus far I have considered 30 days a month, and 12 months a year, which is the general method in casting interest: but by this method 5 days are lost in a year; 12 × 30 = 360 days; which in large sums would amount to something worthy of notice.

To cast interest for any number of days, allowing three hundred sixty-five days to a year.

Rule. Reduce the given number of days to the decimal of a year, which contains 365 days: then multiply the principal, rate, and time together, point off for decimals according to the rule, and it is done.

Examples.

1. What is the interest of $21·20 cts. for 27 days, at 9 per cent. per annum.

$$27 \text{ days is } \frac{27}{365} = ·0739.$$

$21·20 × ·09 × ·0739 = ·14 cts. 1† mill Ans.

2. What is the interest of $12·06, for 3 years 141 days at 6 per cent. per annum ?

Ans. $2·45†.

3. What is the interest of $3·03, for 136 days, at 6 per cent. per annum ?

Ans. ·06 cts. 7† mills.

CASE V.

When the time is months, and the rate per cent. is six.

Rule. Multiply the principal by half the number of months, (which is just equal to the rate for the time when the annual rate per cent. is six) if the months are odd, annex ·5 to the right hand, the product is the interest for the time.

Examples.

1. What is the interest of 21 dollars for 10 months, at 6 per cent. per annum ?

½)10 months=·05 × $21=$1·05 cts. *Ans.*

2. What is the interest of 250 dollars 11 cents, for 16 months, at 6 per cent per annum ?

Ans. $ 20·00 cts. 8† m.

3. What is the interest of $121·12 cents, for 21 months, at 6 per cent. per annum ?

Ans. $ 12·71 cts. ·7† m.

4. What is the interest of 9 dollars, 9 cents, for 9 months, at 6 per cent. per annum ?

Ans. ·40 cts. 9† m.

CASE VI.

When the time is months, and the rate any other than six.

Rule. Find the rate for the time by proportion. Say, as twelve months is to the rate per annum, so is the given number of months to the rate for the time.

Examples.

1. What is the interest of $26·21 cts. for 8 months, at 9 per cent. per annum ?

To find the rate for the time say

Months. *Per cent.* *Months.*
As 12 : 9 : : 8 : 6 the rate for that time.
$26·21 × ·06 rate=$1·57·2 *Ans.*

2. What is the interest of $12·11 cts. for 21 months, at 11 per cent. per annum ?

Ans. $2·33 ·1† m.

3. What is the Interest of 111 dolls. for 13 months at 10 per cent. per annum? *Ans.* 12·02·5.

4. What is the interest of $19 for 22 months, at 12 per cent. per annum? *Ans.* $4·18 cts.

CASE VII.

When endorsements are made on notes, &c.

Rule i. Find the amount of the note to the end of the first year; and find also the amount of all the endorsements (made in that year,) and subtract the amount of the endorsements from the amount of the note, the remainder will be a principal for the second year: then proceed from year to year; the last principal thus found will be what is due on final settlement. By this method the endorsements are applied to keep down the interest.

Rule ii. By a statute of Massachusetts, the following rule is established to cast interest upon securities, where endorsements have been made, viz. find the interest upon the note to the time of the first payment, and add it to the principal; and from the sum subtract the payment at that time made.

Note. If the endorsement is not equal to the interest at that time due, the interest is cast to the next endorsement, and the two endorsements are added together, and their sum is subtracted; the remainder forms a new principal, interest on which must be cast to the next endorsment, &c. the next endorsement must be taken therefrom; and thus proceed through the whole.

Examples by the first method.

1. Mr. Jenkins borrows of Mr. Thorndike 1000 dollars, and promises to pay it to him in one year, at 6 per cent. Mr. Jenkins in six months after, is able to pay 500 dollars, and actually pays it, and it is endorsed on the note: at the end of the year settlement is demanded; for what sum is settlement made?

1000 × ·06 × 1 year = $60 + 1000 = 1060 amount of note.
500 × ·06 × ·5 do. = 15 + 500 = 515 do. of endorsement.

Ans. $545 due on settlement.

The same question by the second method.

$1000 × ·06 × 6 mo.=$30+$1000=$1030 amount in 6 months.

500 endorsement sub.

$530 new principal.

$530 × ·06 × 6 mo.=$15·90+$530=$545·90 due on settlement.

·90 cents difference in the two methods.

By method first.

2. Mr. Jenkins borrowed of Mr. Thorndike, $20000 for one year at six per cent. per annum; in three months after, Mr. Jenkins is able to pay 5000 dollars and Mr. Thorndike is willing to receive it, and it is endorsed on the note: at the end of the year, settlement is made; I demand the sum due on settlement.

$20000 × ·06 × 1 year=$1200+$20000=$21200 amount of note.

$5000 × ·06 × 9 mo.=225+5000=5225 amount of endorsements.

Ans. $15975 due on settlement.

Example second, by method second.

$20000 × ·06 × 3 mo.=300+20000=$20300 am't in 3 mo.

5000 endor. sub.

$15300 new prin.

$15300 × ·06 × 9 mo.=$688·5+15300=$15988·5 due on settlement. $13·50 difference in the two methods.

N. B. The reader will observe that the two methods do not agree, and the reason is obvious: in the first example by method first, Mr. Jenkins pays Mr. Thorndike 500 dollars six months before his note was due, and on settlement

Mr. Jenkins charges Mr. Thorndike with the use of 500 dollars, six months, in addition to the principal sum then paid, (and I conceive it just and right, for he might have put the 500 dollars to use, to some other person, and not have paid Mr. Thorndike till his note was due; and then he certainly would have had the amount of 500 dollars to have met Mr. Thorndike's demand, viz. 515,) and Mr. Thorndike would demand of him 1000 dollars and one years interest, viz. $1060—$515=$545 due on settlement, same as by method first.

Note ii. By the second method the interest of 1000 dollars is found for the first six months, and added to the principal, and then the 500 dollars is subtracted, and interest is cast on the remainder for the remaining six months; thus it is obvious that the 30 dollars interest, that was added at the expiration of the first six months, absolutely became a part of the principal, and carried interest the remaining six months; and of course makes the difference in the two methods.

$30×·06×6 months=·90 cents the difference as before.

Note iii. In the second question you will see that the difference in the two methods is 13 dolls. 50 cents; and it is the interest of the 300 dollars which was added at the expiration of the first three months, when the endorsement was made, and of course it became a part of the principal, and bore interest the remaining nine months.

$300×·06×9 months=$13·50.

These notes will be abundantly sufficient to explain the cause of the difference in the two methods of operation; and I submit it to the publick to judge of the correctness of the two methods alluded to.

For my own part I cannot conceive any propriety in adding the interest to the principal, till one year has expired: and I do not see any injustice in the creditor's paying interest for the money received within the year, if the debtor pays him interest for all the money received of him, to the end of the year: therefore I give my preference to the first method of operation.

CASE VIII.

To find the amount of a note by the help of tables, shewing the amount of $1 from 1 to 30 years, inclusive.

TABLE,

Shewing the amount of one dollar for any number of years from one, to thirty years: at six per cent. per annum, simple interest.

years.	*amount.*	*years.*	*amount.*
1=	$1·06	16=	$1·96
2=	1·12	17=	2·02
3=	1·18	18=	2·08
4=	1·24	19=	2·14
5=	1·30	20=	2·20
6=	1·36	21=	2·26
7=	1·42	22=	2·32
8=	1·48	23=	2·38
9=	1·54	24=	2·44
10=	1·60	25=	2·50
11=	1·66	26=	2·56
12=	1·72	27=	2·62
13=	1·78	28=	2·68
14=	1·84	29=	2·74
15=	1·90	30=	2·80

The use of this table is plain, for if one dollar will amount to $1·06 in one year, ten dollars will amount to ten times that sum for the same time, &c.

TABLE,

Shewing the amount of one dollar from 1, to 12 months, at six per cent. per annum, simple interest.

mo.	*amount.*	*mo.*	*amount.*
1=	$1·005	7=	$1·035
2=	1·01	8=	1·04
3=	1·015	9=	1·045
4=	1·02	10=	1·05
5=	1·025	11=	1·055
6=	1·03	12=	1·06

Examples.

16
36

1. What will 16 dollars amount to in six years at 6 per cent?

$1 in 6 years amounts to $1·36 × 16$ = $21·76 Ans.

2. What will 211 dollars amount to in 9 years at 6 per cent?

$1 in 9 years amounts to $1·54 × $211 = $324·94 Ans.

3. What will 25 dollars amount to in 10 months at 6 per cent?

$1 in 10 months amounts to $1·05 × $25 = $26·25 Ans.

4. What will 61 dollars amount to in 7 months at 6 per cent?

$1 in 7 months amounts to $1·035 × $61 = $63·135 Ans.

COMPOUND INTEREST.

Compound interest is the interest of the interest: when interest is not paid yearly it ought to become a part of the principal.

Rule. Find the interest of the principal for one year, and to the interest add the principal, this sum will be the principal for the second year; thus continue to add the last interest and last principal together, for a new principal, until you have found the amount for the number of years required: from the last amount subtract the first principal, and the remainder is the interest sought.

Examples.

1. What is the compound interest upon 100 dollars for 3 years, at 6 per cent. per annum?

100	1st principal.
·06	
6·00	1st interest.
100·	1st principal added.
106·00	2d principal.
·06	
6·3600	2d interest.
106·	2d principal added.
112.3600	3d principal.
·06	
6·741600	3d interest.
112·3600	3d principal added.
119·101600	3d amount.
100·000000	1st principal subtracted.

Ans. $19·1016

Method second.

RULE. Find what aliquot part the rate per cent. is of one hundred: divide the principal by the aliquot part, or parts, and set the quotient, or quotients under the principal, the same as quotients in short division; add the quotients and principal together, the sum is the second principal; divide the second principal in the same manner, by the aliquot parts, &c. the sum of the quotients, &c. is the second principal; thus continue till you have found the amount required, from which subtract the first principal, the remainder is the interest sought.

Examples.

1. What will 112 dollars amount to in 4 years, at 6 per cent. compound interest?

5 per cent. is equal to	$\frac{1}{20}$	112·00	
1 per cent. is equal to $\frac{1}{5}$ of 5	$\frac{1}{5}$	5·60	1 year's int.
		1·12	
5 per cent. is equal to	$\frac{1}{20}$	118·72	1st. amount.
1 per cent. is equal to $\frac{1}{5}$ of 5	$\frac{1}{5}$	5·936	2d year's int.
		1.187†	
5 per cent. is equal to	$\frac{1}{20}$	125·843	2d amount.
1 per cent. is equal to $\frac{1}{5}$ of 5	$\frac{1}{5}$	6·292	3d year's int.
		1·258†	
5 per cent. is equal to	$\frac{1}{20}$	133·393	3d amount.
1 per cent. is equal to $\frac{1}{5}$ of 5	$\frac{1}{5}$	6·669†	4th year's in.
		1·333†	
		$141·395	Ans.

2. What is the amount of $2·12 cents for 4 years at 12 per cent. per annum? Ans. $3·33·4†.

3. What is the compound interest of $33·33 cents 2 years at 10 per cent.? Ans. $6·99·9†.

4. What is the amount of $6·66 cents 2 years at 9 per cent. per annum? Ans. $7·91.2†.

Method Third.

TABLE,

Shewing the amount of one dollar for any number of years under thirty, at six per cent. per annum, compound interest.

1=$1·06000
2= 1.12360
3= 1·19101
4= 1·26247
5= 1·33822
6= 1·41852
7= 1·50363
8= 1·59384
9= 1·68948
10= 1·79084
11= 1·89829
12= 2·01219
13= 2·13292
14= 2·26090
15= 2·39655
16=$2·54035
17= 2·69277
18= 2·85434
19= 3·02559
20= 3·20713
21= 3·39956
22= 3·60353
23= 3·81975
24= 4·04893
25= 4·29187
26= 4·54938
27= 4·82234
28= 5·11168
29= 5·41838
30= 5·74349

The use of this table is obvious, for if one dollar in one, two, or three, &c. years, will amount to the sum which stands against the particular year, it is evident that any sum of dollars multiplied by the amount of one dollar for the same time will be the amount required.

Examples.

1. What will 50 dollars amount to in 6 years at 6 per cent. compound interest?

$1 in 6 years amounts to $1·41852×$50=$70·926 Ans.

2. What will 505 dollars amount to in 5 years at 6 per cent. compound interest?

$1 in 5 years amounts to $1·33822×$505=$675·801† Ans.

3. What will $222·22 amount to in 4 years at 6 per cent. compound interest?

$1 in 4 years amounts to $1·26247×$222·22=$280·546† *Ans.*

SINGLE FELLOWSHIP.

Single Fellowship teaches to find the gain or loss of each, of several persons, who have joined their stocks for an equal time in trade.

Rule. As the sum of all their stocks is to the sum of gain or loss, so is each man's particular stock, to his particular share of the gain or loss.

Examples.

1. A. B. C. and D. joined their stocks, and bought 367 barrels of beef which they sold at $2·75 advance upon the barrel; A.'s stock was 562 dollars; B.'s 646 dollars; C.'s 394 dollars; and D.'s 600 dollars: I demand the share of each?

367 barrels of beef at $2·75 cents advance=$1009·25 gained.

$562 A.'s stock.
646 B.'s do.
394 C.'s do.
600 D.'s do.

		dolls. cts.		*dolls.*		*dolls. cts.*	
As 2202	:	1009·25	: :	562	:	257·58$\frac{734}{2202}$	A.'s share.
2202	:	1009·25	: :	646	:	296·06$\frac{734}{2202}$	B.'s "
2202	:	1009·25	: :	394	:	180·58$\frac{734}{2202}$	C.'s "
2202	:	1009·25	: :	600	:	275·00 -	D.'s "
						1009.25 *proof.*	

N. B. To prove single, or double fellowship; add the several shares of the gain, or loss together; if the sum is like the sum that was gained, or lost, the work is right.

2. Three men built a ship which cost 4560 dollars: $\frac{1}{4}$ of her belonged to A.: $\frac{2}{5}$ to B.: and the remainder to C.: they agreed to give her a cargo of lumber worth 1270 dollars, in proportion to their shares; and send her to the W. I. She was lost: I demand the loss of each.

Ans. A. lost $1457·5 : B. lost $2332: C. lost $2040·5.

DOUBLE FELLOWSHIP.

Double Fellowship teaches to find the shares of gain, or loss of several persons, who have joined their stocks in trade for unequal times.

Rule. Multiply each man's stock by the time it was in trade; then say, as the sum of the products is to the gain or loss, so is the product of each man's stock and time, to his share of the gain or loss.

Examples.

1. A. commenced trade with a capital of 500 dollars: in 1 month after, he received B. as a partner, with a capital of 450 dollars; in 3 months after this they received C. with a capital of 900 dollars; they traded 4 years from the time that A. commenced business, and gained 3420 dollars; I demand the gain of each?

	stock. *mo.*	
A.'s stock multiplied by the time	500 × 48 = 24000	A.'s
B.'s stock multiplied by the time	450 × 47 = 21150	B.'s
C.'s stock multiplied by the time	900 × 44 = 39600	C.'s
	$84750	

	dolls.		*dolls. cts.*	
84750 :	3420 : :	24000 :	968·49$\frac{47250}{84750}$	A.'s share.
84750 :	3420 : :	21150 :	853·48$\frac{67000}{84750}$	B.'s do.
84750 :	3420 : :	39600 :	1598·01$\frac{65250}{84750}$	C.'s do.

2. A. began trade with a capital of 1300 dollars; he traded 9 months and died: B. offered the family to continue the business, if they would allow his time to be equal to A.'s stock; and divide the gain accordingly; it was so agreed, and he continued business 1 year and 3 months from the death of A.: I demand the share of each, allowing the gain to have been 392 dollars.

A.'s capital 1300 dollars and in trade 2 years. B.'s time valued $1300, and in trade, 1 year and 3 mo.

The heirs of A. had $241·23$\frac{3900}{50700}$.
B. $150·76$\frac{46800}{50700}$ *Ans.*

3. B. and D. joined stocks, viz. 500 dollars each; they traded 2 years, and B. took out one fifth of his stock, and they continued their trade 3 years longer, and gained 627 dollars; what is the share of each?

Ans. A.'s share $333·51$\frac{3}{47}$, and B.'s $293·48$\frac{44}{47}$.

PRACTICE IN AMERICAN MONEY.

TABLE OF PARTS OF A DOLLAR.

1 Cent is = $\frac{1}{100}$	10 Cents is = $\frac{1}{10}$
2 do. is = $\frac{1}{50}$	20 do. is = $\frac{1}{5}$
3 do. is = $\frac{3}{100}$	30 do. is = $\frac{3}{10}$
4 do. is = $\frac{1}{25}$	40 do. is = $\frac{2}{5}$
5 do. is = $\frac{1}{20}$	50 do. is = $\frac{1}{2}$
6 do. is = $\frac{3}{50}$	60 do. is = $\frac{3}{5}$
7 do. is = $\frac{7}{100}$	70 do. is = $\frac{7}{10}$
8 do. is = $\frac{2}{25}$	80 do. is = $\frac{4}{5}$
9 do. is = $\frac{9}{100}$	90 do. is = $\frac{9}{10}$

CASE I.

When the price is cents, and the quantity whole numbers; or if there are fractions in the quantity, such as ½ ¼ ¾, &c.

Rule. If the quantity is a whole number multiply the quantity by the numerator of the fractional part, that the cents are of a dollar, and divide the product by the denominator of the same fraction, the quotient is the answer in dollars, &c. If the quantity has a fraction such as ½ ¼ ¾ &c. express them decimally and divide as before.

Examples.

1. What will 29 bushels of corn come to at ·30 cts. per bushel?

30 cts. = $\frac{3}{10}$ 29 bu.
3
10)87
$ 8·70 *Ans.*

2. What will 126½ yds. come to at ·20 cts. per yard?

20 cts. = $\frac{1}{5}$)126·5 quantity.
$ 25·30 *Ans.*

3. What will 256 yds. come to at ·15 cts. per yard?

Ans. $ 38·40.

4. What will 79 bushels come to at ·65 cts. per bushel? *Ans.* $ 51·35.

5. What will 10 bushels come to at ·90 cts. per bushel? *Ans.* $9.

6. What will 14 bushels come to at ·95 cts. per bushel? *Ans.* $ 13·30.

CASE II.

When the price is dollars and cents.

Rule. Multiply the quantity by the dollars, and for the cents work as in case first: add the two quantities together the sum is the answer.

Examples.

1. What will 22 thousand boards come to at $9·25 cents per thousand?

25 cts. = ¼)22 quantity
9 dol.

198·
5·50

$ 203·50 *Ans.*

2. What will 20 barrels of cider come to at $2·16 a barrel? *Ans.* $ 43·20.

3. What will 122 bushels of corn come to at $2·25 per bushel? *Ans.* $274·50

CASE III.

When the quantity has several denominations, such as cwt. qr. lbs. &c. and the price has dol. cts. &c.

Rule. Multiply the dollars in the price into the whole numbers of the quantity; and work for the cents in the price as in case first: for the parts in the quantity divide by the aliquot parts of the price of one whole number: add the several parts together, the sum is the price of the whole.

Examples.

1. What will 9 cwt. 3qr. 12lbs. of sugar come to at \$ 12·35 cts. a cwt.?

30 cts. = $\frac{3}{10}$ of 1 dol. $\frac{3}{10}$)9 cwt.
12 dol.

108 price of 9 cwt. at 12 dol. [per cwt.
·05 cts. = $\frac{1}{6}$ of 30 cts. $\frac{1}{6}$) 2·70 price of 9 cwt at 30 cts.
·45 price of 9 do. at 5 do.

\$111·15 price of 9 do. at \$ 12·35.

For the parts in the quantity say—

d. c.
2 qr. = $\frac{1}{2}$ cwt. $\frac{1}{2}$)12·35 price of 1 cwt.

1 qr. = $\frac{1}{2}$ of 2 qr. $\frac{1}{2}$) 6·17·5 price of 2 qr.
14 lb. = $\frac{1}{2}$ of 1 qr. $\frac{1}{2}$) 3·08·7† price of 1 qr.
1·54·3† price of 14 lb.

\$ 10·80·5 price of 3 qr. 14 lb.
111·15 price of 9 cwt. at \$ 12·35

Ans. \$ 121·95·5 price of 9 cwt. 3 qr. 14 lb.

2. What will 122 yds. 1 qr. 1 na. of cloth come to at \$ 5·45 cents per yard? *Ans.* \$ 666·60·2.

TARE AND TRET.

Tare and tret are allowances made the buyer by the seller, for the weight of the box, cask, &c.

Tare is an allowance for the weight of the cask; and is generally at a certain rate per cwt. or per barrel, &c.

Tret is an allowance for the waste by dust, and is generally at the rate of 4 lbs. per every 104 lb. &c.

Cloff is an allowance made the buyer for the turn of the scale, and is generally at 2 lb. per 3 cwt.

Gross is the whole weight of the goods together with the weight of the cask, or box, &c. that contains them.

Suttle is when part of the allowance is deducted.

Neat is the remainder after all deductions are made.

CASE I.

When the tare is at a certain rate per hhd. &c.

Rule. Multiply the allowance per box, &c. by the number of boxes, &c. then subtract the product from the gross weight, the remainder is the neat weight required.

Examples.

1. What is the neat weight of 3 hhd. of tobacco, which weigh 13 cwt. 2 qr. 27 lb. tare at 1 cwt. 1 qr. per hhd.?

cwt. qr. lb. cwt. qr. cwt. qr. lb.
13 2 27—1 1 × 3=9 3 27 *Ans.*

2. What is the neat weight of 910 bags of India sugar, each weighing 1 cwt. 2 qr. 20 lb. tare at the rate of 15 lb. per bag? *Ans.* 1405 cwt. 2 qr. 14 lb.

CASE II.

When the tare is at a certain rate per cwt.

Rule. If the rate per cwt. is an aliquot part, divide the gross by the aliquot part, or parts, and the quotient, or quotients will be the tare of the whole, which must be subtracted from the gross; the remainder will be the neat weight required.

Examples.

1. What is the neat weight of 19 cwt. 3 qr. 26 lb. gross, tare at 2 qr. per cwt.?

cwt. qr. lb.
2 qr. = ½ of 1 cwt. ½)19 3 26 gross
9 3 27 tare subtract.

Ans. 9 3 27 neat.

2. What is the neat weight of 347 bags of sugar, each weighing 2 cwt. 3 qr. 12 lb. tare 21 lb. per bag?
Ans. 926 cwt. 1 qr. 13 lb.

CASE III.

When the tare is at a certain rate per cwt. and is no aliquot part.

Rule. Say by simple proportion as 112 lb. is to the rate per cwt. so is the number of lbs. gross to the tare required; which being subtracted from the gross, the remainder is neat.

Examples.

1. What is the neat weight 38 cwt. 0 qr. 4 lb. of tobacco at the rate of 11 lb. per 112 lb.?

cwt. qr. lb
38 0 4=4260 pounds.

lb. *lb.* *lb.*
As 112 : 11 : : 4260 : $418\frac{44}{112}$ tare.

lb. *lb.* *lb.* *cwt. qr. lb.*
4260—$418\frac{44}{112}$=$3841\frac{68}{112}$ neat=34 1 $5\frac{68}{112}$ *Ans.*

CASE IV.

When tare and tret are allowed.

Rule. Find and subtract the tare, as in the preceding cases; the remainder is suttle, divide the suttle by 26 (N. B. $\frac{4}{104}=\frac{1}{26}$.) The quotient is the tret, which subtract, and the remainder is the neat weight.

Examples.

1. What is the neat weight of 5 cwt. 2 qr. of allum; tare 12 lb. per cwt; and tret at the rate of 4 pounds per every 104?

cwt. qrs. lb. *lb.* *lb.* *lb.* *lb.*
5 2=616. As 112 : 12 : : 616 : 66 tare

lb. *lb.* *lb.* *lb.* *lb.* *lb.*
and 616—66=550 suttle. 550÷26=$21\frac{4}{26}$ tret.

lb. *lb.* *lb.* *cwt. qrs. lb.*
and 550—$21\frac{4}{26}$=$528\frac{22}{26}$ neat=4 2 $24\frac{24}{26}$ *Ans.*

2. What is the neat weight of 21 cwt. 1 qr. 26 lb. of rice: tare 15 lb. per cwt. and tret 4 lb. per 104?
Ans. 1991$\frac{334}{1456}$ *lb.*

CASE V.

When tare, tret and cloff are allowed.

Rule. Find and subtract the tare and tret as in the preceding cases, and divide the remainder by 168 the quotient is cloff, which subtract, and the remainder is the neat weight sought.

Examples.

1. What is the neat weight of 10 cwt.: tare 14 lb. per cwt.: tret 4 lb. per 104: and cloff 2 lb. per every 3 cwt.?

cwt. qr. lb.
14 lb. = $\frac{1}{8}$ of 1 cwt. $\frac{1}{8}$)10 0 0 gross.
1 1 0 tare sub.

lb. *lb.* *cwt. qrs.* 8 3 0
As 112 : 14 :: 8 3 : 0 1 9$\frac{9}{13}$ tret sub.

cwt. *lb.* *cwt. qr. lb.* 8 1 18$\frac{4}{13}$
As 3 : 2 :: 8 1 18$\frac{4}{13}$: 0 0 5$\frac{665}{1092}$ cloff.

Ans. 8 1 12$\frac{763}{1092}$ neat.

DISCOUNT.

Discount is a certain sum of money abated for the ready payment of money due at a future time.

CASE I.

Rule. As the amount of 100 dollars for the time given is to 100 dollars; so is the given sum, to its present worth: subtract the present worth from the given sum, the remainder is the discount.

Examples.

1. A. owes B. 1000 dollars payable in one year: A. offers to pay the ready money if B. will make discount at 6 per cent.: I demand the discount to be made?

dolls. *dolls.* *dolls.* *dolls.*
As 106 : 100 : : 1000 : 943·39$\frac{66}{106}$ present worth.
dolls. *dolls.* *dolls.*
And 1000—943·39$\frac{66}{106}$ = 56·60$\frac{40}{106}$ discount. *Ans.*

N. B. It is thought by many, that the interest of the sum for the time, is the discount which ought to be made: but this is an error. I shall here observe if B. had discounted the interest of 1000 dollars for a year, the discount would have been 60 dollars; and he would have had but 940 dollars in ready money, which allow him to receive, and put at interest to a third person; and at the end of a year he would receive but $ 996·40 cents for the 1000 dollars; therefore he receives $3·60 less, than he would have received of A. had it remained in his hands: But allow B. to receive 943·39$\frac{66}{106}$ cents of A. in ready money; and put it at interest to D. in one year it would amount to just 1000 dollars: Therefore by this rule neither party suffers any injury.

2. What discount must be made on 560 dollars due in 9 months: discount at 8 per cent. per annum?

Ans. $ 31·69$\frac{86}{106}$ cts.

RULE II.

As the amount of 100 dollars for the time and rate per cent. is to the interest of 100 dollars for the time and at the rate per cent. so is the given sum to the discount to be made.

Examples.

1. What is the discount upon 1000 dollars due in a year: at 6 per cent per annum?

dolls. *dolls.* *dolls.* *dolls. cts.*
106 : 6 : : 1000 : 56·60$\frac{40}{106}$ *Ans.*

2. What is the discount upon 560 dollars due 9 months hence ; at 8 per cent. per annum ?

Ans. $\$31·69\frac{18}{106}$.

3. What is the discount upon 75 dollars due in 3 years : at 3 per cent. per annum ?

Ans. $\$6·19\frac{29}{109}$.

EQUATION OF PAYMENTS.

The use of this rule is to find a certain time to make a payment of several sums of money at once, due at several different times.

Rule. Multiply each separate payment by the time when it would become due ; add the several products together for a dividend : add the several separate payments together for a divisor ; divide, and the quotient is the equated time.

Examples.

1. A. owes B. 100 dollars payable in 9 months : 72 dollars payable in 6 months : and 200 dollars payable in 22 months : in what time may A. pay all the notes at once, that neither party shall not be liable to suffer any harm ?

First payment 100×9 mo. $= 900$
second do. 72×6 mo. $= 432$
third do. 200×22 mo. $= 4400$

372 5732

$5732 \div 372 = 15$ mo. $12\frac{96}{372}$ days *Ans.*

2. C. owes D. 100 dollars on demand ; 100 dollars in one year ; 100 dollars in two years ; 100 dollars in three years ; what is the equated time to pay all at once ? *Ans.* $1\frac{1}{2}$ years.

ALIGATION MEDIAL.

Aligation medial is a rule made use of, to find the price of a compound of several things mixed together: the prices of the ingredients and quantities being known.

Rule. As the sum of all the quantities is to the total value of all the quantities, so is any part of the mixture to the price of that part.

Examples.

1. A farmer mixes 4 bushels of blighted corn at ·42 cents per bushel; 6 bushels of oats at ·33 cents: 5 bushels of barley at ·96 cents; and 15 bushels of potatoes at ·20 cents per bushel: what is one bushel worth?

	bush.		*cts.*		*D. cts.*		*bush.*		*cts.*	
Corn	4	at	·42	=	1·68					
Oats	6	at	·33	=	1·98					
Barley	5	at	·96	=	4·80					
Potatoes	15	at	·20	=	3·00					
As	30	:			11·46	::	1	:	$38\frac{1}{5}$	*Ans.*

2. A trader mixes 60 gallons of rum at ·90 cents; with 62 gallons at ·80 cents; 40 gallons at ·45 cents; and 10 gallons of water: what is 10 gallons worth?
Ans. $0·70·6†.

3. A trader mixes 1 cwt. of sugar at 10 dollars per cwt. with 3 cwt. at 12 dollars, and adds 40 lbs. of sand to the mixture; what is the value of 1 cwt. of the mixture? *Ans.* $10·55†.

ALIGATION ALTERNATE.

Aligation alternate is a rule made use of to find the quantity of any number of simples, whose prices are given, that will make a mixture worth a certain price, therefore it is the reverse of aligation medial, and may be proved thereby.

CASE 1.

Rule. Write down the prices of the several simples in a column, one above the other, beginning with the least, &c. on the left of the column draw a perpendicular line; and on the left of the line, write down the price of the mixed quantity: then connect with a curved line each of the simples which is less, with one that is greater than the mixed quantity; and set the difference between the least simple (and price of the mixed quantity) against the simple that is largest; and the difference of the larger against that which is less, &c. after having connected each simple that is less with one that is greater, and found the differences; the figures standing against each simple will express the quantity that must be taken of that price, to form a mixture of the price intended.

Examples.

1. A farmer would make a mixture, of corn at ·50 cents; oats at ·25 cents; barley at ·90 cents; and potatoes at ·20 cts. per bushel: I demand the quantity of each that must be taken, that the mixture may be worth ·30 cents per bushel.

The price of the mixture.			
cts. ·30	20	·60 bushels of potatoes,	*will make a mixture worth ·30 cents per bushel.*
	25	20 bushels of oats,	
	50	5 bushels of corn,	
	90	10 bushels of barley	

Proof by aligation medial.

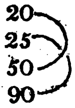
Bushels 60 × ·20 cts. = $12·00
20 × ·25 cts. = 5·00
5 × ·50 cts. = 2·50
10 × ·90 cts. = 9·00

As 95 : 28·50 :: 1 *bush.* : ·30 *cts.* *Ans.*

Note. Questions in this rule admit of a great variety of answers, according to the manner of their being linked together; and yet the value of the mixture will be the same.

The first example linked another way.

The price of the mixture. cts. ·30



20 bushels of potatoes,
60 bushels of oats,
10 bushels of corn,
5 bushels of barley
} *will make a mixture worth thirty cts. per bushel.*

Proof by aligation medial.

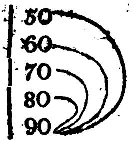
Bushels 20 × ·20 cts. = $4·00
60 × ·25 cts. = 15·00
10 × ·50 cts. = 5·00
5 × ·90 cts. = 4·50

bush. *cts.*
As 95 : $28·50 :: 1 : ·30 *Ans.*

2. A seller of wines would mix wine at ·90 cts. ·80 cents, ·70 cts. ·60 cts. and ·50 cts per gallon; and take such a quantity of each, that the mixture may be worth ·85 cents per gallon; I demand the quantity of each that may be taken.

This question admits of a variety of linkings.

The price of the mixture. cts. ·85



		gallons	*cts.*	
50	5	5 at	·50	Answers.
60	5	5 at	·60	
70	5	5 at	·70	
80	5	5 at	·80	
90	25+25+15+5=	80 at	·90	
		100		

CASE II.

When the mixture is limited to a certain quantity.

Rule. Find a quantity that will compose a mixture by case first; then say as the sum of the quantities thus found, is to the limited quantity, so is each particular quantity found, to the part of that quantity.

Examples.

1. A seller of liquors would make a cask of cherry of 80 gallons: and would compose it of rum at ·50 cts. and ·90 cts. per gallon, and of water: I demand the quantity that must be taken, allowing the mixture to be worth ·60 cts. per gallon.

N. B. This question admits of but one linking,

The price of the mixture.	*cts.* ·60	00	30	30 gallons of water.
		50	30	30 gallons of N. E. rum.
		90	60+10=	70 gallons of W. I. rum.
				130 sum of all the quant.

	Galls.		*galls.*		*galls.*			
As	130	:	80	::	30	:	$18\frac{60}{130}$ of water	*Ans.*
	130	:	80	::	30	:	$18\frac{60}{130}$ of N. E. rum	
	130	:	80	::	70	:	$43\frac{10}{130}$ of W. I. rum	

CASE. III.

When one of the simples is limited to a certain quantity.

RULE. Find the quantities that will make a mixture by case first, (the simple that is limited must be linked) then say, as the quantity that stands against the price of the limited quantity, is to the other quantities taken separately, so is the limited quantity to to the quantity of each.

Examples.

1. A grocer has 40 lbs. of tea worth ·30 cts. per lb. which he would mix with other teas at ·90, ·80 and ·70 cts. per lb.: what quantity of each must be taken, that the mixture may be worth ·60 cts. per lb.?

The price of the mixture.	·60 *cts.*	30	30+20+10=60	*Answers.*
		70	=30	
		80	=30	
		90	=30	

	lbs.		lbs.		lbs.		lbs.		lbs.	Proof.
As	60	:	30	: :	40	:	20	Answers.	20 × ·70 =	$14.00
	60	:	30	: :	40	:	20		20 × ·80 =	16.00
	60	:	30	: :	40	:	20		20 × ·90 =	18.00
The limited quantity							40		40 × ·30 =	12.00
									100 lbs.	60 dolls.

lbs. dolls. lb.
As 100 : 60 : : 1 : ·60 cts. *Ans.*

EXTRACTION OF THE SQUARE ROOT.

Extracting the square root, is the finding of a number, which being multiplied into itself will produce the given number, or is the finding the root of a square number.*

Roots	1,	2,	3,	4,	5,	6,	7,	8,	9.
Squares	1,	4,	9,	16,	25,	36,	49,	64,	81.

Rule. Point the given number into periods of two figures each; beginning at the place of units, thus, 134567: If the point happen to fall upon the last figure, it must be considered as a full period, thus, 12345; secondly, having pointed the number into periods of two figures each: begin at the left hand, and find the greatest spuare that can be had in that period; place the root thereof in the quotient, and its square under the first period, subtract it therefrom, and to the remainder bring down the next period, and call it the resolvend: double the quotient or root, and use it for a divisor; divide the resolvend, omitting the right hand figure, and place the answer in the quotient, and also at the right of the last divisor; multiply the divisor by the figure last put on its right, and in the quotient; place the product under the resolvend, and subtract it therefrom, and to the remainder bring down the next period; double the right hand figure of the last divisor, and use it for a new one: divide the resolvend as before, omitting its right hand figure; thus continue, until the periods are all brought down, the quotient is the root sought.

---

* A number is said to be squared when it is multiplied into itself.

Examples.

1. The square root of 37491129 is required.

```
6×6=36 greatest sqr.)37491129 (6123 root or ans.
                     36
                     --
                  121)149
                      121
                      ---
                 1222)2811
                      2444
                      ----
                12243)36729
                      36729
                      -----
                      .....
```

2. What is the square root of 8896451041? *Ans.* 94321.

3. I demand the square root of 10201. *Ans.* 101.

4. The square root of 36481 is required. *Ans.* 191.

Note. If a remainder is left after the periods are all brought down, annex periods of cyphers, and continue the operation to any exactness: the root thus found, must be expressed decimally.

Examples.

1. The square root of 234321 is required. *Ans.* 484·067+.

2. The square root of 345678 is required.
Ans. 587·94†.

3. The square root of 490023 is required.
Ans. 700·016†.

4. The square root of 9432410 is required.
Ans. 3071·22†.

5. The square root of 87643211 is required.
Ans. 9361·7†.

6. The square root of 67432345 is required.
Ans. 8211·7†.

7. The square root of 40000000 is required.
Ans. 6324·5†.

CASE II.

To extract the square root of whole numbers and decimals.

RULE. Prepare the decimals by annexing cyphers (if occasion require) so that a dot may fall on units place of the whole numbers, then proceed as in case first.

Examples.

1. The square root of 1·4884 is required.

```
     1·4884(1·22 root Ans.
     1
    ----
  22)48
     44
    ----
 242)484
     484
    ----
```

2. The square root of 12·123 is required.

The decimal prepared 12·1230. Root 3·48† Ans.

3. The square root of 9·131 is required.
Ans. 3·03†.

4. The square root of 20·3331 is required.
Ans. 4·509†.

5. The sqaure root of 11·1111 is required.

Ans. 3·3333+.

CASE III.

To extract the square root of Vulgar Fractions.

Rule. Reduce compound fractions to simple ones, mixed numbers to improper fractions, and all to a common denominator, and also to its lowest terms: then extract the root of the numerator for a new numerator, and the root of the denominator for a new denominator.

Note. If the fraction be a surd, that is such an one whose root can never exactly be found, reduce it to a decimal, and extract the root.

Examples.

1. The square root of $\frac{3044}{6849}$ is required.

$\frac{3044}{6849} = \sqrt[2]{\frac{4}{9}} = \frac{2}{3}$ *Ans.*

2. The square root of $\frac{486}{726}$ is required.

$\frac{486}{726} = \sqrt[2]{\frac{81}{121}} = \frac{9}{11}$ *Ans.*

3. The square root of $\frac{294}{1014}$ is required.

$\frac{7}{13}$ *Ans.*

SQUARE ROOT APPLIED.

CASE I.

To form a square from any number, and to know how many can be upon a side.

Rule. The square root of the number given, will be the number upon the side of the square.

Examples.

1. It is required to lay out 25600 square rods of land in a square: I demand the side of the square that will contain the land.

$\sqrt[2]{25600} = 160$ rods on a side.

2. A gentleman purchased 3025 tiles for the purpose of paving a square yard: I demand the number that can be upon a side.

$\sqrt[2]{3025} = 55$ upon a side.

3. A certain General commanded an army of 49284 men; and the better to secure his standard, he gives orders to form into a square body 4 feet distance: I demand the number of men upon a side: and also the quantity of land they occupied.

$\sqrt[2]{49284} = 222$ men upon a side, and they occupied 18 acres, 16 rods $\frac{10800}{27225}$.

CASE II.

Square root applied in finding the diameters of circles by having the area given.

Rule. Divide the area by ·7854, the square root of the quotient is the diameter.

Examples.

1. I demand the length of rope to be tied to a horse's neck, that he may graze upon 7854 square feet of new feed every day, for 4 days: one end of the rope being each day fastened to the same stake.

sq.feet 1st.diamt.

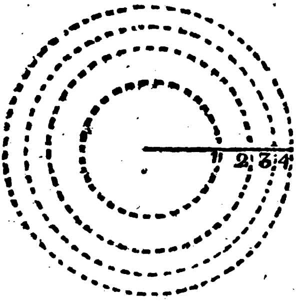
1st Circle contains 7854 $\div$ ·7854 $= \sqrt[2]{10000} = 100$ $\div \frac{1}{2} = 50$ feet the first rope.

2d Circle contains 15708 $\div$ ·7854 $= \sqrt[2]{20000} = 141+$ $\div \frac{1}{2} =$ 70·5 feet the second rope.

3d Circle contains 23562 $\div$ ·7854 $= \sqrt[2]{30000} = 173+$ $\div \frac{1}{2} =$ 86·5 the third rope.

4th Circle contains $31416 \div \cdot 7854 = \sqrt{40000} = 200 \div \frac{1}{2} = 100$ the fourth rope.

The Figure.



The first day the horse will graze from the centre to 1; the second day to 2; the third day to 3; and the fourth day to 4; and will each day graze on the same quantity of new feed.

2. Admitting the preceding figure to represent a grindstone, the diameter of which is 200 inches; the stone was purchased equally between A. B. C. and D. who agreed that D. should wear off his share first; and each man to have it alternately, till they had worn off their shares; I demand how much each man must wear off, that they may have equal shares in the stone.

Ans. D. 13½ in.; C. 16 in.; B. 20½ in.; and A. 50 in.

CASE III.

Square root applied in finding sides to right angled triangles.

Theorem First.

Any two sides given, to find the third. The base and perpendicular given, to find the hypothenuse.

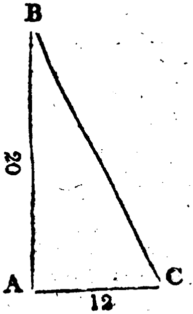
Rule. Square the base and perpendicular, add the two squares together, extract the root of their sum: the root is the hypothenuse.

Examples.

1. A man wishes to make a ladder, that will reach from the eaves of his house, to the ground, 12 feet from

the bottom of the house; the eaves of the house are 20 feet from the ground; I demand the length of the ladder.

B A and A C given to find B C.



20×20=400
12×12=144 ft.

$\sqrt[2]{544}=23{\cdot}3\dagger$ B C Ans.

Theorem Second.

The base and hypothenuse given, to find the perpendicular.

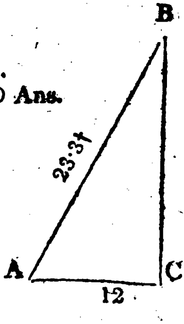
Rule. Square the base and hypothenuse; subtract the least from the greatest; extract the root of the remainder, the root is the answer, or perpendicular.

Examples.

1. What is the height of the eaves of a house that requires a ladder 23·3† feet long to reach from the ground to the eaves; allowing the bottom of the ladder to stand 12 feet from the bottom of the house?

A B and A C given to find C B
A B 23·3×23·3=542·89†
A C 12·×12 =144·

ft. ft.
$\sqrt[2]{398{\cdot}89}=19{\cdot}9\dagger$ or 20 Ans.



Theorem Third.

The hypothenuse and perpendicular given, to find the base.

Rule. Square the hypothenuse and perpendicular, subtract the less from the greater, extract the root of the remainder; the root is the answer or base.

CUBE ROOT.

A Cube is the third power of any number; *that is*, any number multiplied by itself, and that product again by the same number, produces a Cube; thus 9×9=81×9=729 is a Cube; and 9 is the root.

EXTRACTION OF THE CUBE ROOT.

The extraction of the cube root is the finding of that number which has been multiplied three times by itself.

Rule. Separate the number into periods of three figures each, beginning in units place; thus, 943213427 find the greatest cube in the first period, place the root in the quotient, and its cube under the first period; subtract it therefrom, and to the remainder bring down the next period, which call the dividend, or resolvend: find a divisor by multiplying the square of the quotient by 300, seek how many times the divisor is contained in the resolvend, and put the answer in the quotient.

To find the Subtrahend.

Multiply the divisor by the last quotient figure, and place the product under the last dividend (units under units, &c.): then square the last quotient figure, and multiply the square by the preceding figures in the quotient, and the last product multiply by 30, and place this product also under the dividend (units under units, &c.): then cube the last quotient figure, and place its cube under the dividend also (units under units, &c.) add the three numbers (which have been placed under the dividend) together, and subtract their sum from the last dividend; and to the remainder bring down the next period of figures, and proceed as before, until all have been brought down, and the quotient is the root.

N. B. The cube root is proved by cubing the quotient or root, and adding in the remainder, if there is any.

Examples.

1. The cube root of 33076161 is required.

3×3×3=27)	33076161(321 root *Ans.*		
	27		
1st Divis. 3×3×300=2700)	6076	1st dividend or resolvend.	
		For the subtrahend.	
	5400	2700×2	=5400
	360	2×2×3×30	= 360
	8	2×2×2	= 8
	5768	the first subtrahend	5768
2d Divis. 32×32×300=307200)	308161	second dividend.	
		for the second subt.	
	307200	307200×1	= 307200
	960	1×1×32×30	= 960
	1	1×1×1	= 1
	308161	second subtra.	308161

EXPLANATION.

In the above example I first found the greatest cube that was in the first period, viz. in 33, which was 27, and its root was 3, which I put in the quotient, and its cube I put under the first period and subtracted it therefrom, and to the remainder (6) I brought down the next period of figures, viz. 076, which completed my first dividend or resolvend.—Then for the first divisor I squared the quotient or root, and multiplied the square by 300, which gave me 2700 for the first divisor; I found my divisor was contained in the dividend but twice, which I put in the quotient.—Then for the subtrahend I multiplied my last divisor, viz. 2700, by the last figure in the quotient, viz. 2, which product I put under the last dividend; and I also squared the last figure in the quotient, viz. 2, and multiplied its square by the preceding figures in the quotient, viz. 3, and that product again by 30, and put this last product under the dividend: I then cubed the last figure in the quotient, viz. 2, and put its cube also under the dividend: I then found the sum of the three last numbers (standing under the dividend) and subtracted their sum from the dividend; and to the remainder, viz. 308, I brought down the next and last period, viz. 161, and proceeded as before.

2. The cube root of 1728000 is required.

Ans. 120.

3. The cube root of 997002999 is required.

Ans. 999.

4. The cube root of 367061696 is required.

Ans. 716

N. B. When there is a remainder after the periods of figures are brought down; annex periods of cyphers (three at once) and point the root for decimals, and proceed as far as you please in decimals; or you may find a denominator to the remainder by the following *Rule*, viz. Square the root and multiply the square by 3: then multiply the root by 3: add the two products together, and their sum is a denominator to the remainder, which fraction must be annexed to the root to make it complete.

CASE II.

When there are decimals annexed to integers.

Rule. Prepare the decimals that a point may fall upon units in the integers, then proceed as in case first.

Examples.

1. The cube root of 1780·360128 is required.
Ans. 12·12.

2. The cube root of 1815·848 is required.
Ans. 12·2.

3. The cube root of 1·442897 is required.
Ans. 1·13.

CASE III.

To extract the cube root of vulgar fractions.

Rule. Extract the root of the numerators and of the denominators, for new numerators, and denominators.

N. B. the fraction must be reduced to its lowest terms; and if it is a surd, reduce it to a decimal.

Examples.

1. The cube root of $\frac{1331}{1728}$ is required.

$$\frac{\sqrt[3]{1331}}{\sqrt[3]{1728}} = \frac{11}{12} \text{ Ans.}$$

2. The cube root of $\frac{729}{1000}$ is required.
Ans. $\frac{9}{10}$.

CASE IV.

To extract the cube root of mixed numbers.

Rule. Reduce the fractional part to its lowest terms, and if it be a surd, reduce it to a decimal and annex it to the whole number, and then extract the root as in case second.

CUBE ROOT APPLIED.

CASE I.

Cube root applied in finding the solidity of globular figures, by having the diameter and solidity of one given.

RULE. Globes are in proportion to one another as the cubes of their diameters; therefore cube the diameter of the given globe, and also of the required globe: and then say as the cube of the diameter of the given globe, is to its solidity; so is the cube of the diameter of the required globe to its solidity.

Examples.

1. If a cannon ball 6 inches in diameter weighs 25 lb.: I demand the weight of another of the like metal, whose diameter is 3 inches.

6×6×6 = 216 the cube of the given diameter.
3×3×3 = 27 the cube of the required diameter.
as 216 : 25lb. : : 27lb. : 3·12lb.† *Ans.*

2. If a ball of silver 12 inches in diameter is worth $600: I demand the value of another ball, whose diameter is 15 inches. $1171·87† *Ans.*

CASE II.

Having one side of a cubical figure given, to find the side of another, that will contain 2, 3, 4, 5 or 6 times as much as the given one.

RULE. Cube the given side, then multiply the cube by the number mentioned in the question, (if 3 times as large, multiply by 3, &c.) the cube root of the product will be the side required.

N. B. If it is required to make one which is 2, 3, 4, 5 or 6, &c. times less than the given one: divide the cube of the given side by the number mentioned in the question, and extract the root of the quotient; the root is the answer sought.

Examples.

1. There is a box that is 3 feet high, 3 feet long and 3 feet wide; I demand the side of another which shall contain 4 times the quantity.

$$3\times3\times3 = 27\times4 = \sqrt[3]{108} = \overset{\text{feet.}}{4{\cdot}7} \text{ nearly } \textit{Ans.}$$

2. There is a box that is 4 feet wide, 4 feet high and 4 feet long: I demand the side of another that shall contain ⅛ of the quantity. *Ans.* 2 *ft.*

PROBLEM III.

To find the side of a cubical box that shall contain a quantity equal to any given solidity.

Rule. The cube root of any solidity is the side of a box that will contain the same quantity.

Examples.

1. There is a cylindrical cistern that contains 3204 solid inches: I demand the side of a cubical box that shall contain the same quantity.

$$\sqrt[3]{3204} = 14{\cdot}12\dagger \text{ in. } \textit{Ans.}$$

2. The side of a cubical cistern, that shall hold just as much liquor as a cask whose solid content is 25519·1196 inches, is required.

$$\sqrt[3]{25519{\cdot}1196} = 29{\cdot}44\dagger \text{ in. } \textit{Ans.}$$

PART II.

MENSURATION

OF

PLANES AND SOLIDS.

DUODECIMALS,

OR

CROSS MULTIPLICATION.

Duodecimals is a rule much used in measuring superficies and solids. It teaches to multiply feet and inches, by feet and inches; the dimensions in superficies and solids are generally taken in feet, inches, and parts of inches: and are marked thus, ft. for feet; (in.) or (′) for inches; (″) for seconds or 12th of inches; (‴) thirds or 12ths, of 12ths, &c. every denomination in duodecimals, from the left hand towards the right, decreases in a twelve fold proportion; thus an inch is one twelfth of a foot: and (1″) is one twelfth of an inch: (1‴) is one twelfth of (1″), &c.

Rule. Write down the multiplicand in whole numbers and parts; and under it write down the multiplier in whole numbers and parts, observing to write feet under feet, inches under inches, &c. begin and multiply the highest denomination of the multiplier into the lowest denomination of the multiplicand: see how many of the next denomination are contained in the product, which number carry, and set down the remainder; and thus proceed until you have multiplied it into all the denominations: and then multiply the next highest denomination of the multiplier into all the denominations of the multiplicand; observing to begin to set down the first product one place to the right of the one above it; and thus proceed to multiply every denomination of the multiplicand by every denomination of the multiplier; removing the first figure of each product one place to the right: lastly, add up the several products in the same order in which they stand, the sum is the answer.

Examples.

1. It is required to multiply 12ft. 9in. by 6ft. 4in.

$$\begin{array}{rrrl}
\text{ft.} & \text{in.} & & \\
12 & 9 & & \\
6 & 4 & & \\
\hline
76 & 6' & & \\
4 & 3 & 0'' & \\
\hline
80 & 9 & 0 & \textit{Ans.}
\end{array}$$

N. B. In this example the highest denomination of the multiplier, *viz.* 6 feet, was multiplied into the lowest denomination of the multiplicand, *viz.* 9 inches; and the product was 54′, in which was 4 of the next denomination, *viz.* 4 twelves, and 6 left, which was set down, and the 4 was carried to the next denomination; I then multiplied the 6 feet into the 12 feet, and added the 4 I carried to the product, and set the whole down: I then multiplied the 4 inches into the 9 inches, removing the product one place to the right, &c.; then added the products together; the sum was 80ft. 9in. *Ans.*

2. It is required to multiply 3ft. 2′ 3″ by 3ft. 2′ 3″.

$$\begin{array}{rrrrrl}
\text{ft.} & ' & '' & & & \\
3 & 2 & 3 & & & \\
3 & 2 & 3 & & & \\
\hline
9 & 6 & 9 & & & \\
 & 6 & 4 & 6''' & & \\
 & & 9 & 6 & 9'''' & \\
\hline
\text{ft.}10 & 1 & 11 & 0 & 9 & \textit{Ans.}
\end{array}$$

RULE II.

Multiply the highest denomination in the multiplier into all the denominations of the multiplicand, and set down the whole products, &c.; then multiply the next highest denomination in the multiplier into all the denominations of the multiplicand, and remove the products one place to the right, and set them all down; proceed thus through all the denominations, observing to set down the whole products each time of multiplying; then add up the several products in the order in which they stand, and carry the same as in Compound Addition, the sum will be the product required.

Examples.

1. What is the product of 12ft. 9in. multiplied by 6ft. 4in.?

	ft.	in.		
	12	9		
	6	4		
	72	54		
		48	36″	
product	80	9	0	*Ans.*

2. What is the product of 3ft. 2′ 3″ multiplied by 3ft. 2′ 3″.?

	ft.	′	″			
	3	2	3			
	3	2	3			
	9	6	9			
		6	4	6‴		
			9	6	9⁗	
pro.	10	1	11	0	9	*Ans.*

3. What is the product of 12ft. 11in. 11sec. multiplied by 12ft. 11in. 11sec.?

	ft.	in.	sec.		
	12	11	11		
	12	11	11		
	144	132	132		
		132	121	121‴	
			132	121	121⁗
pro.	168	9	10	0	1 *Ans.*

NOTE. This method need not be confined to 12, as some imagine, but may be extended to any denomination.

Examples.

1. Required to multiply 22 yards, 2ft. 11in. by 7 yards, 2ft. 2in.

yds.	ft.	in.		
22	2	11		
7	2	2		
154	14	77		
	44	4	22″	
		44	4	22‴
176	2	7	3	10 *Ans.*

2. It is required to multiply 10 rods 20 links, by 12 rods and 20 links.

N. B. Twenty-five links make 1 rod.

	rds.	links	
	10	20	
	12	20	
	120	240	
		200	400
rods	138	6	000 *Ans.*

Note. In the last example I multiplied 12 rods into 20 links, $12\times20=240$, and then $12\times10=120$ and set down the products as they are.

Secondly. I multiplied the 20 links into 20 links, $20\times20=400$, and then $20\times10=200$, and set down the products as they are, observing to remove the products one place towards the right; then I added up the several products and carried one for every 25 (the number of links generally contained in 1 rod) and the sum is 138 rods six twenty-fifths, as above.

3. It is required to multiply 7 feet 3 inches by 3 feet 3 inches.

$$\begin{array}{rrl}
\textit{feet} & ' & \\
7 & 3 & \\
3 & 3 & \\
\hline
21 & 9' & '' \\
1 & 9 & 9 \\
\hline
23 & 6 & 9 \textit{ Ans.} \text{ equal to } 23\tfrac{9}{16} \text{ feet.}
\end{array}$$

N. B. The 6 inches are $=\frac{6}{12}$ and the $9''=\frac{9}{144}$ of a foot, and $\frac{9}{144}+\frac{6}{12}=\frac{9}{16}$ as expressed above.

Note. Any question that is solved by duodecimals may be solved by vulgar, or decimal fractions.

4. It is required to multiply 8 feet 3 inches by 4 feet 3 inches.

$$\begin{array}{rrl}
\textit{feet} & ' & \\
8 & 3 & \text{duodecimally} \\
4 & 3 & \\
\hline
33 & 0 & '' \\
2 & 0 & 9 \\
\hline
35 & 0 & 9 \text{ equal to } 35 \text{ ft. } \tfrac{1}{16} \text{ of a foot.}
\end{array}$$

The same question by vulgar fractions.

8 ft. 3 in. $=8\frac{1}{4}$, and $8\frac{1}{4}$ is equal to $\frac{33}{4}$. 4 feet 3 inches$=4\frac{1}{4}$, and $4\frac{1}{4}=$to $\frac{17}{4}$, and $\frac{33}{4} \times \frac{17}{4} \equiv \frac{561}{16} = 35\frac{1}{16}$ ft.

The same question by decimal fractions. [*Ans.*

8 ft. 3 in.$=8{\cdot}25$ ft. and 4 ft. 3 in.$=4{\cdot}25$ ft. and $8{\cdot}25\times4{\cdot}25=35{\cdot}0625$ ft., or $35\frac{1}{16}$ ft. *Ans.*

5. It is required to multiply 3 ft. 9 in. by 6 ft. 9 in.
Ans. 25 ft. 3′ 9″ or $25\frac{44}{144}$ ft.

The same question solved by vulgar fractions.

$3\frac{9}{12}=\frac{45}{12}$ and $6\frac{9}{12}=\frac{81}{12}\times\frac{45}{12}=\frac{3645}{144}=25\frac{45}{144}$ ft. *Ans.*

SUPERFICIAL MEASURE.

Superficial measure is that which respects length and breadth, without regard to thickness: and the dimensions are various according to the nature of the thing measured; land is measured by superficial measure, and its dimensions are generally taken in acres, rods and links: boards, &c. are also measured by superficial measure, dimensions are taken in feet and inches, &c.

Artificers' work is calculated by different dimensions.

Glazing by the square foot.

Masons' flat work, such as plastering by the square foot or yard.

Painting, paving, &c. by the yard.

Partitioning, flooring, roofing, tiling, &c. are calculated by the square of 100 feet.

Brick work is generally calculated by the solid foot.

General rule.

Multiply the length by the breadth, the product is the superficial content, or area, in the same measure, or dimension, as that which the dimensions were taken in; if yards, then the area is yards, if feet then the area is feet, &c.

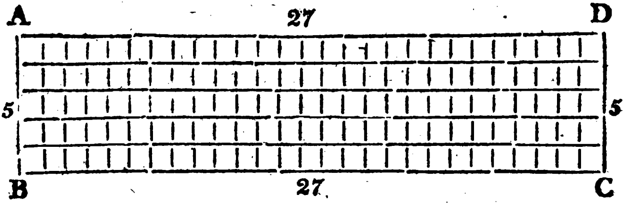
CASE I.

To measure, or find the area of a board, or any other plane surface whose width is equal.

N. B. Such a figure is called a parallelogram.

Rule. Multiply the length by the breadth, and such dimension as the length and breadth are taken in, such will be the dimension of the area; if feet, the area will be square feet, &c.

Note. It is obvious that if the length of any plane surface is multiplied into the breadth, that the product will be the area in square measure, as may be more fully understood by the following figure.



It is evident from the above figure, that if the length B C 27, be multiplied by the width A B, or C D 5, the product will be 135, and will be the number of squares contained in the figure: and it need not be argued that if these dimensions were taken in feet, that the area would be square feet, if taken in rods, or yards, that the area would be rods, or yards, &c.

Examples.

1. What is the area of a floor that is 22 feet 6 inches, by 14 feet 9 inches?

	feet	'	''
	22	6	
	14	9	
	308	84	
	198	54''	
Area	331	10	6 *Ans.*

2. How many boards will cover a floor of a hall, that is 41 ft. 9 in. by 30 ft. 6 in. allowing the floor to be 2 boards thick? *Ans.* 2546 ft. 9 in.

3. How many square feet are in a board that is 21 feet long, and 11 inches wide?

	feet.	'	
	21	0	
	0	11	
ft.	19	3	0'' *Ans.* $=19\frac{3}{12}$ square feet.

4. How many square feet of boards will it take to lay a floor that is 28 feet 6 inches long, and 14 feet 6 inches wide?

Ans. 413 *feet.* 3 '

CASE II.

To measure a board or any other plane, when it is wider at one end than the other, and of a true taper.

Rule. Add together the width of the two ends, and half the sum is the mean width; or take the width in the middle (which is the same as the half of the sum of the width of the two ends,) then multiply the length by the mean width.

Examples.

1. What is the superficial content of a board, that is 1 foot 7 inches wide at one end, and 7 inches at the other; and 23 feet 11 inches long?

ft. *in.* *in.* *ft.* *in.* *ft.* *in.*
1 7+7=2 2 ÷ ½=1 1 mean width.
1 ft. 1′ × 23ft. 11′=25 ft. 10′ 11″ *Ans.*

2. What is the area of a piece of land that is 30 rds. long; 20 rds. wide at one end, and 18 rds, at the other? *Ans.* 570 rds.

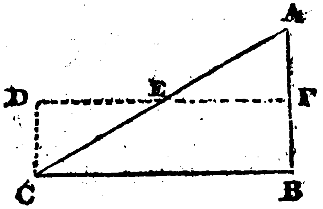
3. What is the area of a hall that is 32 ft. long; 22 feet wide at one end, and 20 at the other? *Ans.* 672 ft.

4. A man has a farm lying 300 rds. on the road, and the width of it at one end is 80 rds. and at the other 60: I demand the content of the farm. *Ans.* 21000 rds., or 131 acres, 40 rds.

CASE III.

To measure the surface of any place in form of a right-angled triangle, [see figure 1.]

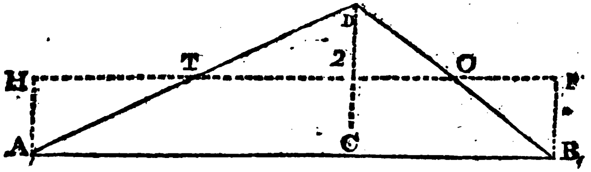
Figure 1.



RULE. Multiply the base C B, by half the perpendicular A B, and the product will be the area; or multiply the base and perpendicular together, and half the product will be the area: also, the perpendicular multiplied by half the base, the product is the area.

NOTE. All triangles, not having one right angle, are in general terms called oblique angled triangles, &c. Figure second represents an oblique angled triangle; and the same rules that apply in measuring a right angled triangle will apply in measuring an oblique angled triangle.

Figure 2.



Note. It is evident that the area of any triangle may be found by multiplying the base by half the perpendicular; or by multiplying the base and perpendicular together, and taking half the product; or by multiplying the perpendicular by half the base. By multiplying half of A B (fig. 1.) by C B, the parallelogram D F C B is measured; E F A is in the triangle, and is not measured; C D E is not in the triangle and is measured in the parallelogram; C D E being equal to E F A there can be no loss sustained.

In figure 2, multiplying half the perpendicular D C, by the base A B, reduces the triangle A D B to the parallelogram H P B A. T 2 D is equal to T H A, and D 2 O is equal to O P B. Therefore it is evident that the parallelogram H P B A is equal in area to the triangle A D B.

Examples.

1. What is the content of a piece of land $13\frac{1}{2}$ rods on the base, (in form of figure 1) and 8·8 rods on the perpendicular?

Half perpendicular $= 4{\cdot}4 \times 13{\cdot}5 = 59{\cdot}4$ rods, *Ans.*

2. What is the area of a piece of ground in form of figure 2d, base 27·4 rods; perpendicular 8·2 rods?

Half perpendicular $= 4{\cdot}1 \times 27{\cdot}4 = 112{\cdot}34$ rods, *Ans.*

3. What is the area of the gable end of a house, beam 40 feet, and height 12 feet 6 inches?

Ans. 500 sqr. ft.

4. What is the superficial content of a piece of board, in form of figure first: the length of which is 16 feet 9 inches, and the wide end 1 foot 10 inches, and the narrow end coming to a point?

ft. in. *in.* *ft. in.* *ft. in ″*
1 10÷½=11×16 9=15 4 3 Ans.

5. What is the content of the second figure, A B 20 feet, and C D 6 feet 4 inches?

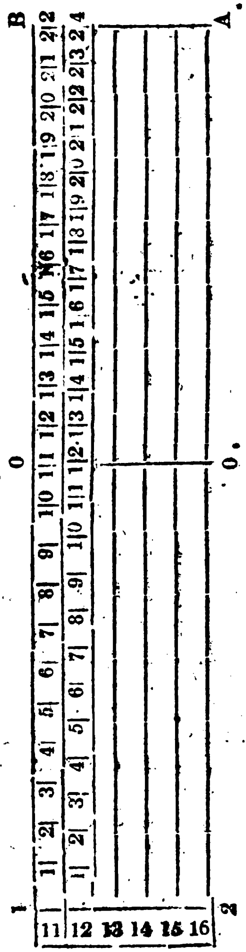
Ans. 63 ft. 4 in.

N. B. The method of measuring every board with the pen, would be too tedious for common practice; I therefore shall show the method of making a board *rule*, and measuring boards with the same.

CASE IV.

TO MAKE A BOARD RULE.

Prepare a rule 2 feet and 1 inch long, and about 3 inches wide, and ½ an inch thick; divide the sides of the rule into 6 divisions, or lines; and each line into two equal parts; or divide two feet of the rule in the middle; at the end of the rule (upon the odd inch, number the lines beginning with 10, and so on to 24; and then begin with the line numbered 10, and divide one foot, on that line, into 10 equal parts, and number each of those parts with 1, 2, 3, 4, &c. on to 20. Then begin with the line numbered 11 at the end, and divide each foot on that line into 11 equal parts, and number each of those parts 1, 2, 3, 4, &c. on to 22; and thus proceed to divide a foot on any line into as many equal parts, as are expressed by the number at the end of the rule; and the rule will appear like the following figure.



One side of the rule.

N. B. At 1, 2, are steel points, and from 2 to A, and from 1 to B is two feet, and the feet are separated by the line O, O.

CASE V.

To measure boards with this rule.

Rule. Find first the length of the board, and then look on the end of the rule for the number corresponding to the length of the board, then apply that line of the *rule* to the middle of the board, and the width of the board will extend on that line to a number expressing its area.

Examples.

1. What is the superficial content of a board, that is 11 feet long, and 12 inches wide? *Ans.* 11 ft.

N. B. The board being 11 feet long, I look for the line numbered 11, at the end, and apply that line to the middle of the board, and the width extends to that division numbered 11, which is its content. *Ans.* 11 ft.

CASE VI.

To measure boards with Gunter's sliding rule.

Rule. Bring ~~12~~ the width on the slider against 12 on the line above; then look along on the line above for the number expressing the length of the board; and against that number, on the slider, stands the number expressing the area of the board.

Example.

1. What is the content of a board that is 18 feet long and 10 inches wide? *Ans.* 15 feet.

N. B. I first slip the slider, so that ~~12~~ the width on the slider stands against 12 on the line above: I then look along on the line above, for the number expressing the length of the board, viz. 18 feet: and against that number (on the slider), stands the number expressing the superficial content of the board, viz. 15.

CASE VII.

To measure boards with Gunter's scale and dividers.

Rule. On the line of numbers extend from 1 to the width, and that extent will reach from the length to the superficial content, or area.

Example.

1. What is the superficial content of a board that is 20 feet long and 1¼ feet wide?

Ans. 25 feet.

Note. On the line of numbers I extend from 1, to 2½ tenths, or ¼ from 1 to 2; and that extent reaches from 20, (the length of the board) to the superficial content 25.

N. B. Any right angled parallelogram can be measured in the same way.

CASE VIII.

To measure joist, plank, &c.

Joists, are of different dimensions, sometimes 3 by 3; and 3 by 4, and 4 by 5, &c. they are sold by the thousand, and are reduced to board measure: that is to say, a joist that is 4 inches wide and 3 thick would make 3 boards, that were 4 inches wide: therefore measure one of the sides in the same manner as if it were a board, by any of the preceding rules in board measure; and then multiply that content by the number of inches it is thick, and the product is the answer.

Example.

What is the superficial area, or board measure of a joist, that is 20 feet long 4 wide, and 3 thick?

20 ft. 0′ × 0 ft. 4′ = $6\frac{8}{12}$ ft. × 3′ thick equal 20 ft. *Ans.*

Note. Plank are sold by the thousand, and are reduced to board measure as joists, and are measured in the same manner.

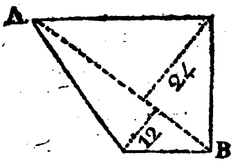
CASE IX.

To measure any irregular plane surface.

Rule. Divide the whole surface into triangles and measure each triangle separately, as taught in case third superficial measure.

Examples.

What is the superficial content of a plat of ground, in form of the following figure?



Divide it into 2 triangles by drawing the diagonal A B, and measure each triangle separately by case 8; diagonal A B 50 feet; Perpendiculars 12 and 24.

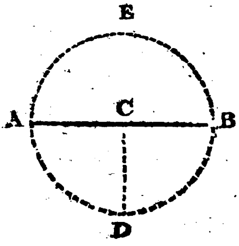
$50\times12+24=1800\div\frac{1}{2}=900$. *Ans.*

CASE X.

To measure the surface of a circle.

Circles are round figures bounded every where by a circular line called the periphery, or arch, or some times the circumference. The line passing through the centre is called the diameter, half the diameter, or a line proceeding from the centre to the periphery is called the semi-diameter, or radius.

See the figure.



A E B D is the periphery or arc.
A B is the diameter of the same.
C D is the semi-diameter or radius.

PROBLEM I.

Diameter given to find the circumference.

Rule. As 7 is to 22 so is the diameter to the circumference; or as 113 is to 355 so is the diameter to the circumference.

Examples.

1. What is the circumference of a circle, which has a diameter of 14 rods?

By Rule 1.—As 7 : 22 : : 14 to 44 rds. Ans.

By Rule 2.—As 113 : 355 : : 14 to $43\frac{111}{113}$ Ans.*

PROBLEM II.

The circumference given to find the diameter.

Rule 1.—As 22 is to 7 so is the circumference to the diameter. Or,

As 355 is to 113 so is the circumference to the diameter. Or, annnex two cyphers to the circumference, and divide the whole by 3·14, the quotient is the diameter nearly.

Examples.

1. What is the diameter of a circle whose circumference is 44 rods?

rods. *rods.*

By Rule 1.—As 22 is to 7, so is 44 to 14 diam.

By Rule 2.—As 355 is to 113 so is 44 to $14\frac{2}{355}$ diam.

PROBLEM III.

The diameter and circumference given to find the area.

Rule. Multiply half the diameter by half the circumference, the product is the answer; or multiply the diameter and circumference together and ¼ the product is the area.

---

* The two methods do not exactly agree, the last method is nearest to the truth; an exact proportion between the diameter and circumference of a circle has not yet been discovered.

Examples.

1. What is the superficial content of a circle whose diameter is 14 rods and circumference 44 rods?

$$\overset{rds.}{14} \div \tfrac{1}{2} \times \overset{rds.}{44} \div \tfrac{1}{2} = 154$$ square rods, *Ans.*

PROBLEM IV.

The diameter given to find the area.

Rule. Multiply the square of the diameter by 0·7854 the product is the area.

Example.

1. What is the area of a circle whose diameter is 14 rods? $14 \times 14 \times 0{\cdot}7854 = \overset{rds.}{153{\cdot}9384}$, *Ans.*

PROBLEM V.

The circumference given to find the area.

Rule. Multiply the square of the circumference by 0·07958, the product is the area.

Examples.

1. What is the area of a circle whose circumference is 44 rods?

$44 \times 44 \times {\cdot}07958 = 154{\cdot}06688$, *Ans.*

PROBLEM VI.

The area of a circle given to find the diameter.

Rule. Divide the area by 0·7854 and extract the square root of the quotent; the root is the diameter sought. (See application of square root, case 2.)

PROBLEM VII.

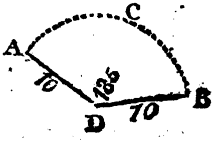
The area given to find the circumference.

Rule. Divide the area by ·07958, and extract the square root of the quotient, and the root will be the circumference sought.

CASE XI.

To measure a sector of a circle.

The sector of a circle is a part of a circle bounded by an arc and two radii drawn to the extremities.



A C B D is a sector, and to measure which find the length of the arc A C B by the following Rule, viz. as 180° is to the number of degrees in the arc, so is 3·1416 times the radius to the length of the arc. Having found the length of the arc A C B, multiply the radius by half the arc, and the product is the area required.

Examples.

1. What is the superficial content of the sector A C B D, the radius A D, or D B being 10 feet, and the arc A C B containing 135°?

As 180 : 135 : : $10 \times 3\cdot1416 : \overset{ft.}{23\cdot562}$ length of the arc.

then $10 \times 23\cdot562 \div \frac{1}{2} = \overset{ft.}{117\cdot81}$ *Ans.*

Rule 2.—Find the superficial content of a circle having the same radius; then say, as 360° (the degrees in a circle) are to the area of the whole circle; so are the number of degrees in the arc of the sector, to the superficial content of the same.

Examples.

1. What is the area of a sector of a circle whose arc contains 45 degrees, and the radius of the same is 20 feet?

If the radius is 20 feet the diameter is 40; if the diameter is 40 the circumference is 125·6†.

$125{\cdot}6 \div \frac{1}{2} \times 40 \div \frac{1}{2} = 1236$ square feet in the circle.

deg. *ft.* *deg.* *ft.*
as 360 : 1236 : : 45 : 154·5 *Ans.*

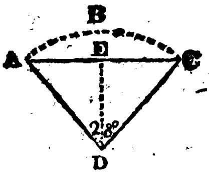
Note. This method is exactly right, for it is evident that if a circle of 40 feet diameter contain 1236 square feet, that a sector of 45° with the same radius will be ⅛ of the circle.

CASE XII.

To measure a segment of a circle.

A segment of a circle is a part of a circle bounded by part of the circle's periphery, and a chord connecting the two extremities of the periphery.

See the figure.



N. B. The quantity of the angle A D C is 82°, instead of 28°.

Rule. A B C is the segment: and to measure which measure the sector A B C D by case 11, and also measure the triangle A D C, and subtract the area of the triangle from the area of the sector; and the remainder will be the area of the segment A B C.

Examples.

1. What is the area of the segment A B C, whose arch contains 82 degrees: and its chord A C 17·5 feet: and the perpendicular of its triangle D E 10·4 feet: and sem-idiameter A D, or D C 13·7 feet?

First, find the area of a circle whose diameter is 27·4 feet.

As 113 : 355 : : 27·4 : $\overset{\textit{ft.}}{86\dagger}$ circumference.
Then say 27·4÷½×86÷½=589·1 area of circle.

To find the area of the sector, say

As 360° : $\overset{\textit{area.}}{589{\cdot}1}$: : 82° : to 134·1 the area of the sector A B C D.

To find the area of the triangle.

The cord A C=17 5, perpendicular D E 10·4×17·5 =182÷½=91 feet area of the triangle A D C.

area of the sector A B C D=134·1
Area of the triangle A D C= 91·0

Area of the segment A B C= 43·1 ft. *Ans.*

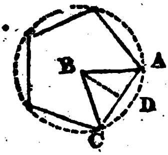
CASE XIII.

To find the area of a polygon, or a figure having equal sides and equal angles.

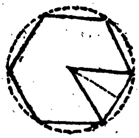
Rule. Multiply half the length of all the sides by the nearest distance from the centre to any of the sides.

Figures.

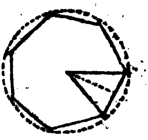
1.



2.



3.



In measuring figure first, it is evident that multiplying the distance from the centre to any one side, by half the length of all the sides is measuring 5 equal triangles; the sides represent the bases, and the distance from the centre, to a side the perpendicular.

Examples.

Fig. 1 A C$=8$.

B D$=5{\cdot}8\times8\div\frac{1}{2}=23{\cdot}2$ area of A B C, and there being 5 triangles contained in this figure, the area of one is $23{\cdot}2 \mid 5=116{\cdot}0$ area of figure 1—and is the same as the distance B D multiplied by half the length of all the sides, viz.

$8+8+8+8+8=40\div\frac{1}{2}=20\times5{\cdot}8=116{\cdot}0$ area as before.

Figure 2. The distance from the centre is 6; the sides are 6 in number, and their length 7:

$6\times7=42\div\frac{1}{2}=21\times6=126$ area of figure 2.

Figure 3 has 7 sides 5·9 long; and the distance from the centre to any side is$=6{\cdot}2$

$5{\cdot}9\times7=41{\cdot}3\div\frac{1}{2}=20{\cdot}65\times6{\cdot}2=128{\cdot}03$ area, figure 3.

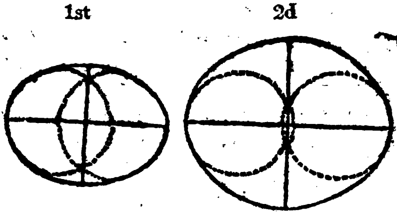
CASE XIV.

To describe and find the area of an ellipsis, or oval.

First, to describe an oval or ellipsis.

Rule. Draw a line and set one foot of the dividers on said line as a centre, and describe a circle, and move the dividers to some other point on the given line (less than the semi diameter) and describe another circle of the same radius, and in the two points where the circle's peripheries intersect, set the dividers and complete the sides of the oval, and through these two points, draw the conjugate diameter, crossing the transverse diameter in the centre of the oval[*]

Figures.



To find the area.

RULE. Multiply the transverse by the congugate diameter, and this again by 0·7854, and the last product is the area ?

N. B. $\frac{11}{14}$ of the product of the two diameters is the area nearly.

Examples.

1. What is the area of figure first, the longest diameter is 17·5 and shortest 13.

$17{\cdot}5 \times 13 \times 0{\cdot}7854 = 178{\cdot}67850$ area.

2. What is the area of figure 2d, the longest diameter being 21 and the shortest 17 ?

$21 \times 17 \times 0{\cdot}7854 = 280{\cdot}3878$ area.
by rule 2d $21 \times 17 \times \frac{11}{14} = 280\frac{7}{14}$ area.

---

[*] The longest diameter of an oval is called the transverse, and the shortest diameter, the conjugate diameter.

CASE XV.

To find the area of a globe or sphere.[*]

Rule. Multiply the diameter and circumference together the product is the area.

Examples.

1. What is the superficial area of a globe whose circumference is 44, diameter 14?

44 × 14 = 616 area *Ans.*

2. What is the area of the world we inhabit, allowing it to contain 360 degrees and 69½ miles to a degree on the equator?

360° × 69½ = 25020 circum. and 7964 diam. nearly.
25020 × 7964 = 199259280 area in square miles.

MENSURATIONS OF SOLIDS.

The mensuration of solids includes the mensuration of all bodies which have length, breadth and thickness; such as timber, stone and wood, &c.

In solid measure 1728 inches make a foot, that is 12 inches in length, 12 in breadth, and 12 in thickness; thus a solid foot would make 1728 little blocks, one inch square.

General Rule.

Multiply the length, breadth and thickness together, the last product is the solidity required.

CASE I.

To find the solidity of a prism.

Note. A prism represents a three cornered file, that is all its length of the same bigness; therefore the ends are triangles.

---

[*] A globe or sphere is a round ball.

Rule. Find the area of one end in inches, multiply this area by the length of the prism, the last product will be the solidity.

Note. If the area of the end is found in inches, and multiplied into the length in inches, the solidity is in solid inches, and must be divided by 1728 to bring it to solid feet; if the area of one end in inches is multiplied into the length in feet, dividing by 144 will give the solidity in solid feet.

Examples.

1. What is the solidity of a prism, the sides of the triangles of which measure 13 inches, and the perpendiculars of its triangle 12 inches; and the length 12 feet?

in. *in.*
$13 \times 12 \div \frac{1}{2} = 78 \times 12$ feet $= 936 \div 144 = 6\frac{72}{144}$ *Ans.*

2. What is the solidity of a prism the base of which is 2 feet 3 inches; and the perpendicular of which is 1 foot 10 inches; and length 20 feet 6 inches?

Ans. 42 feet 3′ 4″ 6‴

CASE II.

To find the solidity of any figure that is of equal width and equal thickness.

Rule. Multiply the length, breadth and thickness together, the last product is the solidity.

Examples.

1. How many solid feet are in a hall, that is 36 feet 6′ long 14 feet 6′ wide and 8 feet 6′ high?

36 feet 6′ × 14 feet 6′ × 8 feet 6′ = 4498 ft. 7′ 6″, or $4498\frac{5}{8}$ ft. *Ans.*

2. How many solid feet will be occupied by 21 chests of tea, which are 3 feet 3 inches every way?

Ans. $720\frac{57}{64}$ ft.

CASE III.

To find the solidity of any figure that has equal thickness, but unequal width.

Rule. Find the mean width by adding together the width of both ends, and taking half the sum for the mean width: the width taken in the middle is also the mean width; multiply the mean width, depth and length together, and the product is the solidity.

Examples.

1. How many solid feet are in a stone that is 21 feet long, 2 feet wide at one end, and 3 feet at the other, and 1 foot 6 inches thick?

2+3=5÷½=2·5×21×1·5=78·75, *Ans.*

2. How many solid feet in a stone wall that is 51 feet long, and 7 feet high, and mean thickness 2 feet 6′? *Ans.* 892½ feet.

CASE IV.

To find the solidity of a cylinder.

Note. A cylinder is a long round body, all of its length of equal bigness.

Rule. Multiply half its circumference by half its diameter, (the product is the area of one end) and this product by the length; the last product will be the solidity required.

Example.

What is the solidity of a cylinder that has a diameter 22 inches and is 20 feet long?

22÷½=11 and 69·14÷½=34·57×11×20=7605·4÷144 equal to 52·81† ft. *Ans.*

Note. Multiply the circumference and diameter together and divide the product by $\frac{1}{4}$; the quotient is the area of one end.

Examples.

1. What is the solidity of a cylinder that has a diameter 9½ feet, and is 21 feet long?

9·5 diam. ×29·85† circumference=283·575÷$\frac{1}{4}$=70·88† area×21 length=1488·69 solidity *Ans.*

2. What is the solidity of a cylinder, whose diameter is 7 inches, and circumference 22, and is 20 feet long?

$7\times22=154\div\frac{1}{4}=38{\cdot}5$ area$\times20=770\div144=5\frac{50}{144}$ [*Ans.*

CASE V,

To measure, or find the solidity of a cone or pyramid.

Note. A Cone is a figure standing upon a base, and of a true slant or taper from the largest end, to a point or vertex. Sometimes the base is circular, square, triangular, or in form of a parallelogram.

Figures.

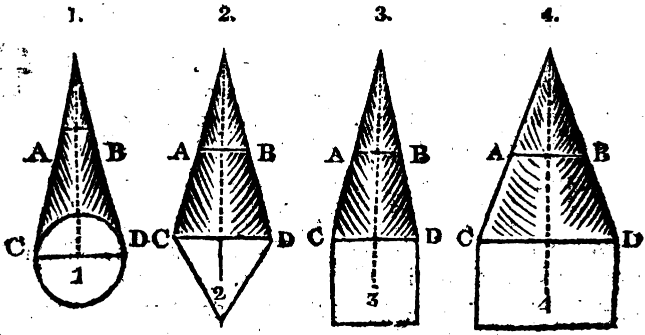


Figure 1, represents a circular cone; figure 2, a a triangular cone; figure 3, a square cone; and figure 4, a parallelogramical cone.

Rule. Find the superficial area of the base, and multiply it into one third of the perpendicular height of the cone, and the product will be the solidity.

Examples.

1. What is the solidity of figure first; perpendicular 21 feet, and the diameter of the circle at the base $9\frac{1}{2}$ feet?

9·5 diameter, 29·85 circumference.

Half diam. and half circum. $4{\cdot}75 \times 14{\cdot}925 = 70{\cdot}89$† area of base.

Area $70{\cdot}89 \times 21 \div \frac{1}{3} = 496{\cdot}23$† feet, solidity.

2. What is the solidity of figure 2d; perpendicular 21 feet, sides of its triangle 10, and perpendicular of its triangle $8\frac{1}{2}$?

$10 \times 8\frac{1}{2} = 85 \div \frac{1}{2} = 42{\cdot}5 \times 21 \div \frac{1}{3} = 297{\cdot}5$ solidity.

3. What is the solidity of figure third; perpendicular height 21, and the sides of its base 9 feet?

$9 \times 9 = 81 \times 21 \div \frac{1}{3} = 567$ ft. *Ans.*

4. What is the solidity of figure fourth: perpendicular height equal 21, and sides 15 by $9\frac{1}{2}$?

Ans. 997·5 ft.

CASE VI.

*To find the solidity of the frustum of a cone, &c.**

Rule 1. Find the superficial area of both ends, add the two areas together, and reserve the sum; multiply the two areas together, extract the square

---

*A frustum of a cone is a piece cut off from the cone parallel to the base; see the figures in case 5th, A B C D are frustums.

Examples.

1. What is the solidity of a wedge that is 12 feet long, 12 wide and 6 thick, at the large end?

$12\times12=144\times6\div\frac{1}{2}=432$ solidity. *Ans.*

2. What is the solidity of a wedge that is 10 feet long, 6 inches wide and 6 inches thick?

Ans. $1\frac{1}{4}$ ft.

CASE IX.

To find the solidity of a wedge when the edge is narrower than the large end.

Rule. To the width of the edge add twice the width of the large end, and reserve the sum; multiply the length of the wedge by the thickness of the large end; multiply this last product and the reserved sum together, and divide by 6; the quotient is the solidity.

Examples.

1. What is the solidity of a wedge that is 12 feet long, and 18 inches wide at the largest end, and 12 inches wide at the edge; and six inches thick at the large end?

Width of the edge - 12
Width large end 18×2 = 36

48 reserved sum.
Length of wedge 144 inches.
Thickness of large end 6 inches.

864 product.

Pro. 864×res. sum 48=41472÷6=6912 in. or 4 ft. *Ans.*

2. What is the solidity of a wedge that is 20 long, 15 wide at the large end, and 10 at the edge; and 12 thick? *Ans.* 1600.

Note. This rule will give the solidity of a cone when it is square, or parallelogramical, &c.

Example.

What is the solidity of the cone, figure third, case fifth ; width of the large end 9, thickness 9, and length 21 ?

Width of the edge 0
Width of large end 9×2 = 18
18 reserved sum.

21 length×9 thickness=189×18=3402÷6=567 *Ans.*

CASE X.

To find the solidity of a globe, or sphere.

N. B. A globe or sphere is a round body bounded by a surface every point of which is equally distant from a point within called the centre ; a line passing from one side to the other through the centre is called the diameter, or axis.

Rule. Cube the diameter, or axis, and multiply its cube by ·5236 the last product is the solidity.

Examples.

1. What is the solidity of a globe, or sphere whose diameter is 113 ?

113×113×113×·5236=768486·9422 solidity.

2. What is the solidity of the world which we inhabit, in miles ; allowing its circumference to be 25000 miles ?

As 22 is to 7 so is 25000 to 7954 diam. nearly.
(Fractions omitted.) 263485304337· solid miles *Ans.*

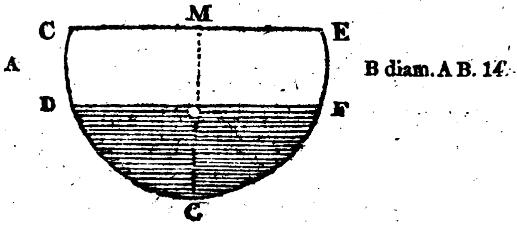
3. What is the solidity of a cannon ball that is 9 inches on its diameter? *Ans.* 381·7044 solid in.

4. What is the solidity of a sphere whose diameter is 2 ft. 8 in.? *Ans.* 9·92† ft. solidity.

CASE XI.

To find the solidity of a segment, or part of a globe, or sphere; or part of a globe cut off parallel to the diameter, as part D G F.

See the Figure.



Rule. Square the radius of its base, (as D o, or F o) multiply its square by 3, and reserve the product; square the depth o G, add the square and reserved product together; and multiply the sum by the depth; and the last product by ·5236; the product is the solidity.

Examples.

1. What is the solidity of the segment D G F, radius D o, or F o 7 and depth o G 5?

Radius 7×7×3=147 reserved product.
Depth 5×5= 25 add

172×depth 5=860×·5236=450·296
[Solidity.

2. Required the solidity of a segment of a globe whose semi-diameter, is 9 in. depth 9 in.?

Ans. 1526·8176 in.

CASE XII.

To find the solidity of the middle zone of a sphere, or globe; or the part of a sphere after two segments have been cut off, parallel to the diameter or axis, as C D E F, *in case eleventh.*

Rule. Square the semi-diameter of both ends and add the squares together, and reserve the sum; square the height, or distance of the two ends as o M, and add ⅓ of its square to the reserved sum; multiply the sum by the height, or distance o M, and this product again by 1·5708; the last product is the solidity.

Examples.

1. What is the solidity of the middle zone C D E F, (case eleventh); diameter C E, or D F, 14 and height o M, 3?

N. B. In this example the diameters are alike which is not always the case.

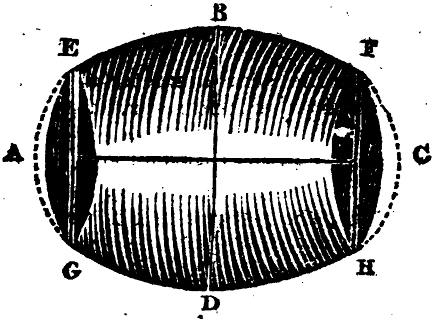
Diam. 14 semi.=7×7=49
Diam. 14 semi.=7×7=49
Height o M 3×3=9÷⅓= 3 add.
—— *ht.*
101x3=303×1·5708=475·9524
Ans.

2. What is the solidity of the middle zone of a sphere whose greatest diameter is 12, and least 8, and height or length, 10? *Ans.* 1340·41†

CASE XIII.

To find the solidity of a spheroid, or elipsoid; and also to find the solidity of the middle frustum of a spheroid.

Note. A spheroid is a solid generated by the revolution of an ellipse, or oval, about the transverse or conjugate diameter. [See the figure A B C D.]



To find the solidity of the spheroid A B C D.

Rule. Multiply the revolving diameter B D, into itself, and the product by the fixed diameter A C, and the product again by ·5236, the last product is the solidity.

Examples.

1. What is the solidity of a spheroid whose revolving diameter B D 20, and fixed diameter A C 30?

Revolv. diameter 20 × 20 = 400 × 30 × ·5236 = 6283·2 [*Ans.*

2. What is the solidity of a spheroid whose revolving diameter is 30, and fixed diameter 50?

Ans. 23562.

To find the solidity of the middle frustum of a spheroid.

Rule. To the square of the diameter of one end, add twice the square of the middle diameter, multiply this sum by the length, and the product again by ·2618 the last product is the solidity.

Examples.

1. What is the solidity of the frustum E F G H length 40, end diameters E G, or F H 24, and middle diameter B D 32. ?

End diam. 24 × 24 = 576
Mid. diam. 32 × 32 × 2 = 2048 add.

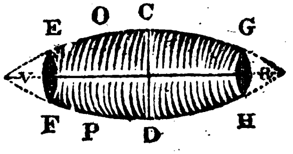
2624 × 40 × ·2618 = 27478·5280
[*Ans.*

2. What is the solidity of the middle frustum of a spheroid length 30, middle diameter 25, end 20 ?
[*Ans.* 12959·1.

CASE XIV.

To find the solidity of an elliptic spindle.

Note. An elliptic spindle is formed by any of the three conic sections revolving about a double ordinate.



Rule. Find the diameter half way between the middle and end, multiply it by two, square the product and add the square to the square of the diameter taken in the middle, multiply the sum by the length, and the product again by ·1309, the last product is the solidity, very nearly.

Examples.

1. What is the solidity of the elliptic spindle V B C D; length 15; diameter C D 5; and diameter taken half way between the middle and end equal to 4?

Least diam. 4×2=8×8=64 sq. of twice of the diam.
Diam. C D 5×5=25 sq. of C D add.

89 sum.
Sum. 89×15×·1309=174·7515 *Ans.*

2. What is the solidity of an elliptic spindle that is 20 in length; greatest diameter 15; and the diameter half way between the middle and end, equal to 10?
Ans. 1636·25

To find the solidity of the middle frustum of an elliptic spindle.

Rule. To the square of twice the diameter taken half way between the middle and the end, add the squares of the middle and end diameters; multiply the sum by the length, and again by ·1309, the last product is the solidity required.

Examples.

1. What is the solidity of the middle frustum E G F H length 10; diameter at the end 4: diameter C D 6, and diameter taken at O P, equal to 5?

Diam. O P $5\times2=10\times10=100$ sq. of twice O P.
Diam. C D $6\times6=36$ sq. of C D.
Diam. E F or G H $4\times4=16$ sq. of E F or G H.

152 sum.
Sum. $152\times10\times\cdot1309=198\cdot968$ *Ans.*

CASE XVI.

Timber measure; the common method.

Rule. The common method of measuring round timber, (in order to ascertain the quantity of hewn timber, that is contained in a round stick) has been to girt the stick in the middle with a line, and then to double the line into four equal parts, (and one of these parts is considered equal to one side of the square timber that can be hewn from such a stick); and one of these parts, (or one fourth of the circumference) is multiplied into itself and again by the length of the stick, the last product is called the solidity.

Note. If $\frac{1}{4}$ of the girt in inches, is multiplied into itself and again by the length in inches, the last product must be divided by 1728, the quotient is the solidity in feet: if $\frac{1}{4}$ the girt in inches is squared and multiplied into the length in feet, the product must be divided by 144; the quotient will be the solidity in feet.

Note. This method of measuring round timber is very erroneous; it gives too much for the solidity of square timber in the stick, and not enough if the four slabs, or segments are to be included; as I shall prove in case 17th.

Examples.

1. What is the solidity of square timber, that can be hewn from a round stick that is 21 ft. long, and its circumference, or girt line 48 inches?

Girt $48\div\frac{1}{4}=12\times12=144\times21=3024\div144=21$ ft. *Ans*

2. What is the solidity of square timber in a round stick that is 30 ft. long, and its circumference or girt measures 24 inches? $7\frac{1}{2}$ ft. *Ans.*

3. What is the solidity of that stick of timber that girts 56 inches, and its length being 11 ft. 9 inches?

Duodecimally. Girt $56 \div \frac{1}{4} = 1$ ft. 2 in. quarter girt.

```
feet  '
  1   2
  1   2
 ------
  1   2
      2   4"
 -----------
  1   4   4  square of qr. girt.
 11   9   0  length.
 -----------
 11  44  44
  4   9  36. 36'''
 ----------------
 15  11  11   0, or 15 143/144 ft. Ans.
```

4. What is the solidity of square timber in a stick of round timber, that girts 50 in. and is 31 ft. 7 in. long?

Ans. 34 ft. 3′ 2″ 10‴ 9⁗ or $34\frac{1868}{6912}$.

NOTE. In all the preceding examples the stick of timber has been considered all of its length, of equal bigness, or a cylinder. If the stick is tapering (as it always is) the common method is to girt it in the middle; and sometimes it is girted in two, or three places, and the sum of the girts is divided by the number of them, and the quotient is taken for the mean girt of the stick.

CASE XVII.

A new method of finding the solidity of square timber that is contained in a stick of round timber, or to find how much the stick will measure after it is hewn.

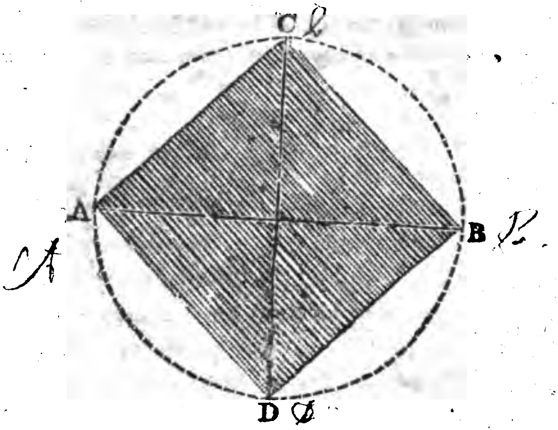
Rule. Girt the stick (after taking off the bark,) and annex a cypher to the girt in inches and divide the whole by 4·4 the quotient is a side of the greatest square that can be hewn from such a stick; multiply this side into itself, and this product again by the length, and the last product will be the solidity of the stick after it is hewn.

The preceding rule illustrated.

Make a circle whose diameter is 20, and of course its circumference will be 62·8†, (which will represent the girt of a stick of timber); annex a cypher to the circumference and divide by 4·4, the quotient is 14 and nearly 3 tenths; now make the largest square in this circle that can be made in it, and you will find that the sides of the square will be 14·3, very nearly. If the above circumference were divided by ¼ the quotient would be 15·7 for a side of square timber that could be hewn from such a stick.

15·7—14·3=1·4 difference.

The following figure will serve to illustrate the rule.



Diameter A B or C D 20, and the sides of the square A D, or D B, or B C, or C A 14·3, and are sides of the greatest square that can be made in the circle.

Examples.

1. What solidity of square timber can be hewn from a stick that is 20 feet long, and girts 62·8 in.?

Girt 62·80 ÷ 4·4 = 14·3 nearly × 14.3 = 204·49 × by length 20 = 4089·80 ÷ 144 = 28·4† solidity *Ans.*

What is the solidity of the above stick of timber allowing ¼ of the circumference to be a side of the square timber, as directed in case 16th.

Girt 62·8 ÷ ¼ = 15·7 × 15·7 = 246·49 × length 20 = 4929·80 ÷ 144 = 34·2† solidity *Ans.*

Note. By comparing the two preceding answers, it is evident that the last method of operation gives too much for the solidity of square timber in such a stick.

Erroneous solidity, as found by rule, case 16, 34·2† ft.
True solidity, as found by rule, case 17, 28·4† ft.

diff. 5·8 ft.

2. What is the solidity of square timber in a stick of round timber, that is 21 feet long, and 48 inches in circumference?

Girt 48·0 ÷ 4·4 = 10·9† a side of sqr. timb. in the stick.
10·9 × 10·9 × 21 = 2495·01 ÷ 144 = 17·32† solidity *Ans.*

The same question solved by using ¼ of the circumference for a side of square timber in the stick.

Girt 48 ÷ ¼ = 12 × 12 × 21 = 3024 ÷ 144 = 21 ft. *Ans.*
Difference 3·68 ft. too much.

3. By duodecimals. What is the solidity of square timber in a stick of round timber, that is 11 ft. 9' long, and girts 56 inches?

Girt 56·0 ÷ 4·4 = 1ft. 0' 8''† a side × 1ft. 0' 8'' = 1ft. 1' 4'' 5''' 4'''' ×
by the length 11ft. 9' = 13ft. 1' 1'' 2''' 8'''', *Ans.*

4. What is the solidity of square timber in a stick of round timber, that is 31 ft. 7 inches long, and girts 50 inches?

Ans. 26 ft. 6' 5'' 7'''.

NOTE. Having shown by the two first questions in this case, that using ¼ of the circumference for a side of square timber, that can be hewn from a stick of round timber, gives too much for the solidity, or more than the stick will measure after it is hewn square; It now remains to show that ¼ of the circumference multiplied in itself, and then into the length, does not produce the solidity of the stick, if the four segments, or slabs are to be included.

Examples.

1. What is the solidity of a stick of timber whose length is 20 ft. cicumference 62·8 in. and diameter, 20 in.; measured by rule, case 16?

Ans. 34·2† ft.

2. What is the solidity of the same stick of timber admitting it to represent a cylinder, and to be measured by the rule for measuring a cylinder. *(See cylinder case 4th.)*

Ans. 43·5† ft.

NOTE. A cylinder is measured by finding the area of one end, and multiplying the area of one end by the length; this gives the exact solidity.

Exact solidity of the stick 43·5† ft.
Erroneous solidity 34·2† ft.

Diff. 9·3 too small.

NOTE. It is obvious from the preceding examples that the square of ¼ the circumference, multiplied by the length, gives too much for the solidity of square timber in the stick, (or more than it would measure if it were hewn square); and not enough if the four slabs, or segments, are to be included: It ought to be a matter of consideration, by those concerned in buying and selling timber, how it should be measured; and if it is agreed by the parties to measure only the square timber, (or what the stick would measure if it were hewn) then apply the rule in case 17th; but if it is agreed to measure the whole solidity of the stick (including the segments, or four slabs,) then apply the rule in the following case.

CASE XVIII.

To find the solidity of a round stick of timber, including the four slabs, or segments.

Rule. Girt the stick of timber in the middle (after taking off the bark), annex two cyphers to the girt, or circumference, and divide by 3·14 the quotient is the diameter nearly; multiply the girt, or circumference and diameter together, and one fourth part of the product multiplied into the length will be the solidity required.

Examples.

1. What is the solidity of a stick of timber, that girts 94·2 in. and length 20 ft.?

$94{\cdot}200 \div 3{\cdot}14 = 30$ diam. $94{\cdot}2 \times 30 \div \frac{1}{4} = 706{\cdot}5 \times 20 \div 144 = 98\frac{18}{144}$ ft. *Ans.*

2. What is the solidity of a stick of timber, that is 22 ft. long; and the girt line measuring 31·4 in.?

Ans. $11\frac{143}{144}$.

Note. In all the preceding examples in timber measure, the timber has been considered of equal bigness from end to end; it now remains to treat of tapering timber, both round and hewn.

CASE XIX.

To find the solidity of hewn timber in a round stick, when the stick is tapering from end to end.

Rule. Girt the stick at both ends, annex a cypher to the girts, or circumferences, and divide each girt by 4·4 the quotients will be sides of square timber; multiply the two sides together; find the difference between the two sides; square the difference, and add one third of its square to the product of the two sides, and multiply this sum by the length, the last product is the solidity required.

Examples.

1. How much hewn timber is in a stick of round timber, that is 24 ft. long, and its circumference at one end is 44 in. and at the other 22 in.?

Cir. $44{\cdot}0 \div 4{\cdot}4 = 10$ a side of the largest square.
Cir. $22{\cdot}0 \div 4{\cdot}4 = 5$ a side of the least square.
Sides of the two squares $10 \times 5 = 50$ product.
Sides $10 - 5 = 5 \times 5 = 25 \div \frac{1}{3} = 8\frac{1}{3}$ added.

$58\frac{1}{3}$ sum.
Sum $58\frac{1}{3} \times 24$ ft. $= 1400 \div 144 = 9\frac{104}{144}$ft. *Ans.*

2. How much hewn timber is in a stick that is 21 feet long, and its circumference at one end is 88 inches, and at the other 44 inches? *Ans.* $35\frac{5}{12}$.

Note. If it is required to find how much hewn timber is contained in a round stick, allowing the square timber to be all its length of equal bigness, the round stick must be girted only at the small end.

CASE XX.

To find the solidity of a round stick of timber which is of a true taper from end to end, including the the four segments, or slabs.

Rule. Apply the rule for finding the solidity of a frustum of a round cone; viz. find the area of the two ends; multiply the two areas together, extract the square root of the product, and add the root to the areas of the two ends; multiply this sum by one third the length, the last product is the solidity.

Examples.

1. What is the solidity of a stick of timber whose largest circumference is 63, and smallest 43 inches; and is 21 feet long?

Cir. $63{\cdot}00 \div 3{\cdot}14 = 20{\cdot}0\dagger$ diam.
Cir. $43{\cdot}00 \div 3{\cdot}14 = 13{\cdot}7\dagger$ diam.

Cir. and diam. $63 \times 20 = 1260 \div \frac{1}{4} = 315$ area, large end.
Cir. and diam. $43 \times 13{\cdot}7 = 589{\cdot}1 \div \frac{1}{4} = 147\dagger$ area, small end.
Areas $315 \times 147 = \sqrt[2]{46305} = 215\dagger$ root add.
677 sum.

Sum $677 \times 21 \div \frac{1}{3} = 4739 \div 144 = 32\frac{131}{144}$ ft. *Ans.*

Note. This method of operation would be too lengthy for common use; and if the following rule be adopted the solidity may be found very near the truth (although a little too small), with much more convenience.

Rule ii. Girt the stick nearly in the middle, annex two cyphers to the girt, and divide by 3·14, the quotient is the diameter nearly; multiply the girt or circumference and diameter together, and ¼ of the product multiplied into the length will give the solidity.

Note. If a stick of timber were girted where it would tip easily, if it were lying upon another log, the preceding rule would give the true solidity of the stick: sometimes the stick may require to be girted in two or three places, and the sum of all the girts divided by the number of them will be the mean girt.

Examples.

1. What is the solidity of a round stick of timber, (including the four segments) which is 12 ft. long; and its middle girt, or circumference is 62·8 inches?

Cir. $62{\cdot}80 \div 3{\cdot}14 = 20$ diam.; and $20 \times 62{\cdot}8 = 1256{\cdot}0 \div \frac{1}{4} = 314 \times 12 = 3768 \div 144 = 26\frac{1}{6}$ ft. *Ans.*

2. What is the solidity of a round stick of timber that is 10 ft. long; and its mean girt 31·4 in. including the four segments or slabs? *Ans.* $5\frac{65}{144}$ ft.

3. What is the solidity of a round stick of timber, whose mean girt is 94·2 inches; and 30 ft. long?
Ans. $147\frac{17}{144}$ ft.

CASE XXI.

To find the solidity of a hewn stick of timber that has all its sides parallel.

Rule.—Multiply one side by the other, and the product multiplied by the length, will be the solidity.

Examples.

1. What is the solidity of a stick of hewn timber that is 30 ft. 6 in. long; and one side is 1 ft. 3 in. the other 6 in.?

30 ft. 6′ × 1 ft. 3′ × 0 ft. 6′ = 19 ft. 0′ 9″, or $19\frac{1}{16}$, ft. Ans.

N. B.—Stone is measured in the same manner as timber.

2. What is the solidity of a stone that is 12 ft. 6 in. long, 4 ft. 10 in. wide, and 0 ft. 9 in. thick?
Ans. 45 ft. 3′ 9″.

NOTE.—When two sides only, of the stick the parallel, multiply the mean width and the other side together, and the product by the length.

3. What is the solidity of a stick of timber that is 12 in. wide at one end, and 8 at the other ; and is 8 in. thick, and 3 ft. 4 in. long ?

Ans. 1 ft. 10′ 2″ 8‴.

CASE XXII.

To find the solidity of a tapering hewn stick of timber, which has no two sides parallel.

RULE.—Apply the rule for finding the solidity of the frustum of a pyramid, see case sixth ; if the stick is square at each end, measure it as in case 6th rule 2.

Examples.

1. What is the solidity of a stick of hewn timber that is 10 inches square at one end, and 4 inches at the other, and is 32 feet long ?

Sides of Sq. $10\times4=40$ pro.
Sides $10-4=6\times6=36\div\frac{1}{3}=12$ add.

Sum 52
Sum $52\times32=1664\div144=11\frac{5}{9}$ft. *Ans.*

2. What is the solidity of a stick of timber that is 15 in. by 12 at one end ; and 9 by 6 in. at the other end, and 21 ft. long ?

Sides $15\times12=180$ area of largest end.
Sides $9\times6=54$ area of smallest end.

234 sum of the two areas.

A. $180\times54=\sqrt[2]{9720}=98\dagger$ root add.

Sum $332\times7=2324\div144=16\frac{5}{36}$ ft. [*Ans.*

Note. The preceding method of measuring hewn tapering timber gives the exact solidity; but the method of taking the dimensions in the middle of the stick does not give the exact solidity, except in such sticks as have two or more sides parallel.

1. Required the solidity of a stick of timber that is 10 by 10 inches at one end, and 4 by 4 at the other end; and is 32 feet long: measured by taking the mean between the two ends?

Sides $10+4=14 \div \frac{1}{2}=7$ mean side.

Mean side $7 \times 7 \times 32=1568 \div 144=10\frac{8}{9}$ *Ans.*

Solidity too small by $\frac{6}{9}$ of a foot, (*see quest.* 1, *case* 22.)

2. What is the solidity of a stick of timber, which is 15 in. at one end, and 12 the other; and on the other side, it is 9 in. at one end, and 6 the other; and is 21 feet in length?

Ends $15+12=27 \div \frac{1}{2}=13\frac{1}{2}$ mean side:

Ends $9+6=15 \div \frac{1}{2}=7\frac{1}{2}$ mean side.

Sides, $\frac{27}{2} \times \frac{15}{2} \times \frac{21}{1} \div \frac{144}{1}=14\frac{401}{576}$ ft. *Ans.*

and is $1\frac{175}{576}$ ft. smaller than the true answer. (*See question* 2, *case* 22.)

Note. This last method of measuring hewn tapering timber, being more convenient than the method of measuring it as a frustum of a cone, it is generally put in practice; if the dimensions were taken where the stick would tip, if it were lying on another log, this method would give the exact solidity.

CASE XXIII.

To find the solidity of timber by Gunter's sliding rule.

To measure timber, allowing $\frac{1}{4}$ of the circumference to be a side of square timber in the round stick.

Rule 1. Look first for the length of the stick in feet upon the brass slider, slip the slider to bring the figures expressing the length, to 12 on the girt line below, then look on the girt line for the quarter girt of the stick, and against the quarter girt (on the sliber) stand the fignres expressing the solidity of the stick.

To find the solidity of a stick of timber, allowing 4·4 of the circumference to be a side of square timber.

Rule 2. Girt the stick where it would tip easy if it were lying upon another log, annex a cypher to the girt in inches, and divide by 4·4, the quotient is a side of square timber: and proceed as above.

To find the solidity of hewn timber by Gunter's rule.

Rule 3. Add the four sides together, take $\frac{1}{4}$ of the sum for the mean side, proceed as above, and the answer will be very near the true solidity.

CASE XXIV.

WOOD AND BARK MEASURE.

Note. Wood and bark are sold by the cord, and 1728 inches make 1 solid foot; 16 solid feet make 1 foot of wood; 8 feet of wood 1 cord; 128 solid feet one cord.

Rule. Multiply the length of the pile in feet and inches, by the width in feet and inches, and that product again by the height of the pile in feet and inches, the last product is the solidity; which divided by 128 the quotient is cords; if any thing remains, divide it by 16, the quotient is feet of wood; if any thing still remains, divide by 4, the quotient will be quarters of a foot of wood, &c.

Examples.

1. What is the quantity of wood in a pile, that is 9 feet 6 inches long, 6 feet wide, and 4 feet 6 inches high?

ft. *ft.* *ft.* *ft.*
9 6′×6 0′×4 6′=256 6′÷128=2 cords ½ sld. ft. *Ans.*

2. What is the solidity of a pile of wood 22ft. 9in. long, 5ft. 8 inches wide, and 2ft. 6in. high?

Ans. 2½† cords.

3. What is the solidity of a pile of bark that is 9ft. long, 10ft. 6in. high, and 4ft. 6in. thick?

Ans. 3⅔ cords.

CASE XXV.

Having the base, or bottom of a pile of wood, or bark given, to find how high to build, that the pile may contain any quantity of wood, or bark required.

Rule. Find the solid feet contained in the pile of wood you would build; reduce these feet to solid inches, and use them for a dividend; find the superficial area of the base in inches, and use them for a divisor; divide and the quotient is the inches in height.

Examples.

1. How high must a pile of wood, or bark be to contain 8 feet of wood, or 1 cord; which stands upon a base 48 in. by 48 in.?

1 cord=128 sld. ft.×1728=221184 sld. in. and dividend.
48 in.×48 in.=2304 area of the base and divisor.
221184÷2304=96 in., or 8 ft. in height *Ans.*

2. I demand the height of a pile of wood that will contain $4\frac{1}{2}$ feet, the base, or bottom of which is 4 by 5 feet. *Ans.* $43\frac{576}{2880}$ in. or 3 ft. $7\frac{1}{5}$ in.

3. I demand the height of a pile of wood, that shall contain 9 feet, that stands upon a base, that is 6 by 5 feet. *Ans.* $57\frac{2592}{4320}$ in. or 4 ft. $9\frac{3}{5}$ in.

CASE XXVI.

To find the solidity of a parallelopipedon.

NOTE. A parallelopipedon is a figure having six rectangular sides, every opposite pair of which are equal and parallel.

RULE. Multiply the length, breadth and depth together the product is the solidity.

Examples.

1. A farmer makes a large chest 21 ft. long, 5 ft. 6 in. wide, and 3 ft. 9 in. high, the solidity of which is required.

21 ft. 0 in.×5 ft. 6 in.×3 ft. 9 in.=433 ft. 1′ 6″ *Ans.*

2. How many solid feet in a cart that is 8 ft. long, 4 ft. 4 in. wide, and 2 ft. 4 in. high?

Ans. 80 ft. 10′ 8″.

CASE XXVII.

To find the solidity of any cube.

Note. A cube is a figure having 6 square sides.

Rule. Multiply one side into another, and this product by the third, the last product is the solidity.

1. What is the solidity of a tea chest that is 3 ft. 6 in. every way?
3 ft. 6′×3 ft. 6′×3 ft. 6′=42 ft. 10′ 6″ *Ans.*

2. How many solid feet will 60 bales of goods occupy in a store; each bale measuring 4 ft. 3 in. every way? *Ans.* 4605 6′ 3″.

3. How many solid feet are in a square room that is 12 feet long, 12 feet wide and 12 feet high? *Ans.* 1728.

4. How many solid feet in a square pillar that is 16 feet square? *Ans.* 4096.

5. There is a pit dug 8 feet deep, 8 feet broad and 8 feet wide; how many solid feet of sand were thrown out of it? *Ans.* 512.

GUAGING.

Guaging is the art of measuring all kinds of vessels, determining the quantity of liquor contained in them; practitioners in the art, generally make their calculations by means of instruments; the instruments used in guaging, are the calipers, Gunter's sliding rule, Gunter's scale, &c. the guaging rod is used to take, or find the outs. The vessels used for liquor are various in shapes and names, viz. pipes, hogsheads, barrels, runlets, &c. also among brewers coolers, backs, vats, &c. are used.

Solidity of liquid measure.

A gallon of wine occupies a space equal to 231 solid inches.
A gallon of beer occupies a space equal to 282 solid inches.
A gallon in corn measure is equal to 268·8 solid inches.
A bushel in corn measure is equal to 2150·4 solid inches.

Generally speaking there are three sorts of casks, which are judged of according to the curvature of their sides, viz.

1. If the sides of the cask are very curving from end to end, it may be said to represent the middle frustum of a spheroid, (see the figure E F G H, case 13 solids.)

2. If the sides of the cask are more straight it more properly represents the middle frustum of an elliptic spindle, (see the figure, case 14 solids.)

3. If the cask is straight from the end to the bung, and of a true taper, (such a cask is rarely found) it represents two frustums of a round cone; the two bases form the middle diameter. (See the frustum of a round cone case 5, solids, figure first,) which represents half of such a cask.

General Rule.

Find the solidity of either of the above figures, (or any other figure) in solid inches, and divide the solidity by 231 for wine gallons; by 282 for beer gallon; and by 268·8 for gallons of grain or corn; and by 2150·4 for bushels of corn; and the quotients will be the answers respectively.

CASE I.

To guage a spheroidical cask.

Rule 1. To twice the square of the bung diameter, add the square of the head diameter, and multiply the sum by the length of the cask, divide the product by 882 for wine, by 1077 for ale, or beer, and by 1026·3 for gallons of corn or grain; and the quotients will be the answers respectively.

Rule 2. Find the solidity of the cask by the following rule, viz. To the square diameter at the end, add twice the square of the middle, or bung diameter; multiply the sum by the length of the cask, and again by ·2618, the last product is the solidity; which divide by 231 for wine; 282 for ale, or beer; and by 268·8 for gallons of corn, or grain: the quotients will be the answers respectively.

Examples.

1. What is the content of a spheroidical cask, in wine, ale or beer, and corn gallons; whose middle or bung diameter B D (see figure, case 13, solids) is equal to 20 inches, and the end diameter E G or F H is equal to 13 inches, and the length of the cask 22 inches?

By rule first.

Bung diam. B D 20 × 20 × 2 = 800 twice the square.
Head diam. E G or F H 13 × 13 = 169 added.
Pro.
sum 969 × 22 length = 21318

Product 21318 ÷ 882 = $24\frac{130}{882}$ gal. of wine *Ans.*
21318 ÷ 1077 = $19\frac{855}{1077}$ gal. of ale or beer, *Ans.*
21318 ÷ 1026·3 = $20\frac{7920}{10263}$ gal. of corn, &c. *Ans.*

By rule second.

Diam. E G or F H 13 × 13 = 169 square of E G or F H.
Bung diam. B D 20 × 20 × 2 = 800 twice square of B D add.
969 sum.

Sum 969 × 22 length = 21318 × ·2618 = 5581·0524 solidity.
Solidity 5581·0524 ÷ 231 = 24·16† gal of wine, *Ans.*
5581·0524 ÷ 282 = 19·79† gal. of ale, &c. *Ans.*
5581·0524 ÷ 268·8 = 20·76† gal. of corn, &c. *Ans.*

Note. Dimensions are always taken in inches; due allowance must be made for the thickness of the heads, &c.

CASE II.

To guage a cask representing the middle frustum of an elliptic spindle.

Rule 1. To twice the square of the bung diameter, add the square of the head diameter and reserve the sum; find the difference between the head and bung diameter, square the difference, and subtract $\frac{2}{5}$ of the square of the difference from the reserved sum; multiply the remainder by the length of the cask; divide the product by 882 for wine; by 1077 for ale or beer; and by 1026·3 for corn, &c.; the quotient will be the answers *in gallons* respectively.

Rule 2. Find the solidity in solid inches by the following rules, viz. To the square of twice a diameter taken half way between the head and bung, (as at o P) add the squares of the head and bung diameters; multiply the sum by the length of the cask, and again by ·1309 for the solidity; divide the solidity by 231 for wine; and 282 for ale, or beer; and by 268·8 for corn, &c.; the quotients will be the answers in gallons respectively.

Examples.

What is the content of a cask representing the middle frustum of an elliptic spindle, (see figure E F, O P, C D, and G H, Case 14, solids) in wine, ale, and corn gallons; whose length is 38; bung diameter C D 22; and end diameter, E F, or G H 16 and a diameter at O P 20·5 inches?

By rule first.

Diam. C D 22×2=44×44=968 square of twice C D.
Diam. E F or G H 16×16=256 square of E F or G H.

1224 reserved sum.
Di. 22—16=6×6=36÷$\frac{2}{5}$=14·4 subtract.
Pro.
1209·6×38=45964·8
Product 45964·8÷882=52·1† gal. of wine *Ans.*
45964·8÷1077=42·5† gal. of ale or beer. *Ans.*
45964·8÷1026·3=44·7† gal. of corn or grain. *Ans.*

By rule second.

Diam. at O P 20·5×2=41×41=1681 square of twice O P.
Diam. C D 22×22 - - - =484 square of C D.
Diam E F or G H 16×16=256 square of E F or G H.

2421 sum.

sum. 2421×38 length×·1309=12042·5382 solidity.
solidity. 12042·5382÷231=52·1† gal. wine. *Ans.*
12042·5382÷282=42·3† gal. of ale, &c. *Ans.*
12042·5382÷268·8=44·7† gal. of corn, &c. *Ans.*

CASE III.

To guage a cask representing two frustums of a round cone, the bases being joined together to form the bung diameter. (See figure 1, *Case* 5, *Solids.)*

RULE I.

Add the two diameters together, square the sum and multiply the square by 3, and reserve the product; find the difference of the diameters; square the difference, and add the square of the difference to the reserved product, and multiply the sum by the length, and the product again by ·00023⅕ for ale, &c. by ·00028⅓ for wine.

RULE II.

Find the solidity of half the cask by the following rule, (half of such a cask would represent a churn, or mash tub, or basket.) viz. find the area of the two ends, supposing the cask to be cut in two, add the areas together and reserve the sum; multiply the two areas together, extract the square root of the product, and add the root to the reserved sum; multiply the sum by ½ the length, and ⅓ the product is the solidity of that part of the cask, which must be doubled to make the solidity; divide the solidity by 231 for wine; by 282 for ale; by 268·8 for corn gals. &c.

Note. To find the area of the ends, multiply the diameter by the circumference, and ¼ of the product is the area.

Examples.

What is the content of a cask representing two frustums of a cone, (see frustum A B C D, figure first, case 5 solids) diameter A B 31, and diameter C D 44; length 55?

By rule first.

res'd pro.
Diam. A B & C D 31+44=75×75=5625×3=16875
Diam. C D & A B 44—31=13×13=169 add.

Sum 17044
Sum 17044×55×·00023$\frac{1}{5}$=217·48144 ale gal. *Ans.*
17044×55×·00028$\frac{1}{5}$=265·60233 wine gal. *Ans.*

By rule second.

As 7 : 22 :: 44 diam. : 138.3† circum.
7 : 22 :: 31 diam. : 97·4† circum.
Diam. 44×by cir. 138·3÷$\frac{1}{4}$=1521·3 area of largest end.
Diam. 31×by cir. 97·4÷$\frac{1}{4}$=754·8† area of small. end.

Areas. 2276·1 reserved sum.
1521·3×754·8=$\sqrt[2]{1148277{\cdot}24}$=1071·5 root added.

3347·6 sum.
Sum 3347·6×half length 27·5÷$\frac{1}{3}$=30686·33 solidity of half the cask.
30686·33×2=61372.66 solidity of the cask.
Solidity 61372·66÷282=217·6† ale gal. &c. *Ans.*
61372·66÷231=265·6† wine gal. *Ans.*

Guaging, Second Method.

Sometimes the following method is used in guaging.

Rule. Measure the diameter of the cask at both ends, and take half their sum for the head diameter;

measure the diameter at the bung, or in the middle of the cask; (dimensions must be taken upon the inside, or else allowance must be made for the thickness of the staves, &c.); measure also the length of the cask, and then make calculations by the following rules, *viz.* Find the difference between the head and bung diameter; multiply it by ·62, and add the product to the head diameter, the sum is the mean diameter of the cask; (and reduces the cask to a cylinder). Square the mean diameter and multiply the square by the length of the cask, and divide by 294.12 for wine; by 359·05 for ale, &c.; by 342·25 for corn gallons; and by 2738 for bushels of corn.

NOTE. These divisors arise by dividing 231, 282 and 268·8 by ·7854; if the square of the mean diameter were multiplied by the length and again by ·7854, the last product would be the solidity of the cask; (see Cylinder, case 4th solids) the solidity being divided by 231 for wine; 282 for ale,; by 268·8 for gallons of corn; &c. the quotients would be the answers in gallons, respectively.

NOTE. Although the number ·62 is generally used by guagers, yet it ought to be varied according to the curvature of the cask; if the cask is very curving like figure, case 13th solids, it would require that the difference between the diameters be multiplied by ·69 or ·7.

If the cask is more straight the number used should be less.

Examples.

1. What is the content of a cask in form of the figure in case 13th solids, whose diameter E G or F H equal 13 and diameter B D 20; and length 22 inches?

Diam. 20—13=7 dif. × ·70=4·90+13=17·9 mean diam. 17·9×17·9×22=7049·02 product.
Product 7049·02÷294·12=24† gal. wine *Ans.*
7049·02÷359·05=19† gal. ale, &c. *Ans.*
7049·02÷342·25=20† gal. of corn *Ans.*

If the cask is more straight, the number ·67 ought to be used.

2. What is the content of a cask representing figure E F C D and G H, case 14th solids; diameter E F or G H equal 16, diameter C D 22; length 38 inches?

Diam. 22—16=6 dif. × ·67=4·02+16=20·02 mean diam.
pro.
Mean diam. 20·02 × 20·02=400·8004 × 38 len.=15230·4152
Pro. 15230·4152÷294·12=51† gal. wine *Ans.*
15230·4152÷359·05=42† gal. ale, &c. *Ans.*
15230·4152÷342·25=44† gal. of corn *Ans.*

3. What is the content of a cask, formed by joining two frustums of a cone together, (the frustum A B C D figure first, case 5th, in solids, represents half of such a cask) diameters 44 and 31, and length 55 inches?

N. B. A cask of this form requires that the difference between the diameters be multiplied by ·515, for ·52 produces too much.

Diam. 44—31=13 dif. × ·515=6·695+31 diam.=37·695 [mean diam.
Mean diam· × 37·695 × 37.695 × 55=78150·216375 pro.
Pro. 78150·216375÷294·12=265·6† gal. wine *Ans.*
78150·216375÷359·05=217·4† gal. ale, &c. *Ans.*

Note. It is evident from the three last examples, that the number ·62 would not exactly apply in either case: the dimensions of the three last examples are the same as the dimensions of the three first examples, by the first method; and the numbers which I have made use of produce the same answers, as were produced by the first method. If the cask is a little straighter than the elliptic spindle, in case 14 solids, the number ·62 will exactly apply; this number should always be varied according to the shape of the cask, and at the judgment of the guager.

4. What is the content of a spheroidical cask, whose length is 20; diameters 16 and 12 inches?
Ans. 14·8† wine, 12·2† ale, &c.

N. B. In this example the number ·7 is used.

5. What is the content of a cask, representing an elliptic spindle, length 40; diameters 32 and 24?
Ans. 117.2† wine, 96·0† ale, &c.

N. B. In this example the number ·67 is used.

6. What is the content of a cask representing two frustums of a cone, diameters 24 and 32; length 40?
Ans. 107·5† wine, 88·09 ale, &c.

N. B. In this example the number ·515 is used.

To guage with calipers, or Gunter's scale.

On the calipers there is a brass pin fixed at the points 17·15 and at 18·95;* these are called guage points; 17·15 is used for guaging wine, &c.; and 18·95 is used for ale, or beer, &c.

Rule. For a cask representing the middle frustum of a spheroid, (see figure, case 13 solids) extend from 1 to ·7;

---

* These numbers are the square roots of the numbers 294·12 and 359·05 respectively.

and with the same extent, set one foot of the dividers in the number expressing the difference between the bung and head diameter, and they will reach to a number, towards the left hand, which, when added to the head diameter will give the mean diameter of the cask; then set one foot of the dividers in the guage point, and extend to the mean diameter; and the same way set off twice that extent from the length of the cask, and they will reach to a number expressing the content of the cask.

N. B. the same operations may be performed on the line of numbers, on Gunter's scale.

N. B. If wine gallons are required use the guage point 17·15; if ale gallons are required use the guage point 18·95; and if corn gallons are required you may use the point 18·5, respectively.

Note. If the cask represents the middle frustum of an elliptic spindle (see figure, case 14 solids) extend from 1 to ·67, or if a little more straight, extend from 1 to ·62; and for a cask formed by two frustums of a cone, extend from 1 to ·51, or ·52.

Examples.

1. What is the content of a cask of rum, or wine whose length is 59·3 inches; and diameters 34·5 and 30·7; difference of diameters 3·8?

Operation.

Extend from 1 to ·62; and that extent reaches from 3·8, (the difference of the diameters) towards the left hand to 2·4 nearly, which add to the head diameter: 30·7+2·4= 33·1 mean diameter; then extend from the guage point 17·15 to 33·1 (the mean diameter), and set off twice that extent from 59·3 (the length of the cask), and they reach to 220·8 nearly, which is the content of the cask.

2. What is the content of a cask of wine whose length is 38; diameters 22 and 16 inches: difference of diameters 6? *Ans.* 52† wine 42† ale, &c.

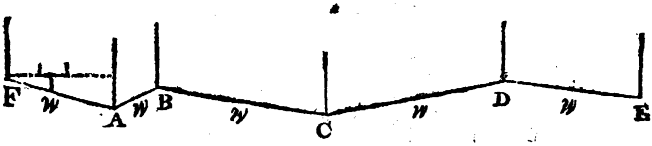
Operation.

Extend from 1 to ·67 ; and that extent will reach from 6, (the difference) to 3·7 nearly : which being added to the head diameter 16, produces 19·7 for the mean diameter : then extend from the wine guage point to 19·7, (mean diameter) and set off twice that extent from 38, the length ; and the dividers rest on 52 the answer.

Note. Guagers make use of the guaging rod, to take the dimentions of the cask ; and there are also tables on it by means of which the outs are taken ; after the preceding rules are well committed to memory, the young practitioner would soon obtain a complete knowledge of guaging, by a little practice with the instruments.

WATER LEVELLING, OR

To find whether water can be made to run from one place to another, or to find how much higher one place is than another.



F is the fountain, and E the place assigned to carry the water to.

Note. To perform this business you must be provided with two staves divided into inches and tenths, which may be of any convenient length perhaps, 4 or 6 feet ; and also a water level which may be made easily at any joiners shop ; the level may be of any convenient length dug out hollowing, so as to hold water ; with two sights at the top to make the observations through : having provided the staves and water level, go to the fountain with two assistants and observe the following rule.

RULE. Order the first assistant to the fountain with one staff placed perpendicularly: and the second assistant to any convenient place as at A, with his staff perpendicularly; then place the water level in the middle between them at *w*, and looking through the sights, order the first assistant to move a piece of white paper up and down the staff till you can see it through the sights: then order him to notice the distance it rests from the ground; and going to the other end of the water level, order the second assistant to do likewise; and after he has marked down the distance the papers rest from the ground, order the first assistant to take the place of the second, and the second to take a new stand, as at B; place the water level between them, make observations as before, and order the assistants to mark down the distances the paper rests from the ground, and proceed to take another station and make new observations till you have arrived to the place assigned; and order the assistants to cast up their notes, and as much as the second assistant's notes exceed the first, so much does the ground descend; and so much as the second assistant's notes are less than the first, so much does the ground rise. In the preceding examples the assistant's notes are as follows.

First assistant's notes.	*ft.*	*in.*
First station	0	7
Second do.	1	0
Third do.	0	2
Fourth do.	1	2
Fifth do.		4
ft.	3	3 in.

Second assistant's notes.	*ft.*	*in.*
First station	1	0
Second do.	0	6
Third do.	1	6
Fourth do.	0	2
Fifth do.	0	7
ft.	3	9 in.

Second assistant's notes exceed the first by 6 inches; of course the ground is 6 inches lower at E, than at F, and water will run.

REDUCTION OF COINS.

New-Hampshire, Vermont, Massachusetts, Connecticut and Rhode-Island currency reduced to dollars, cents, &c. and the contrary.

CASE I.

When the sum to be reduced is pounds only.

Rule. To the pounds annex a cypher, and divide by three, the quotient is dollars; if there is a remainder, annex 3 cyphers, and divide by 3 again, the quotient will be dimes, cents and mills.

Examples.

1. Reduce £621 to dollars, &c.
£6210÷3=$2070 *Ans.*

2. Reduce £19 to dollars, &c.
£190÷3=$63·333† *Ans.*

3. Reduce £121 to dollars, &c.
£1210÷3=$403·333† *Ans.*

4. Reduce £16 to dollars, &c.
$53·333† *Ans.*

CASE II.

When the sum to be reduced is pounds, shillings, pence and farthings.

Rule. To the pounds annex half the number of shillings (and two cyphers in decimals); if the number of shillings in the sum are odd, annex the greatest even half, and 5 tenths for the odd shilling (and one cypher); if there are pence and farthings in the sum, reduce the pence to farthings; observing to increase their sum by 1, if it exceeds 12; if it exceeds 37, add two; and add the farthings in the place of decimals, and divide the whole by 3, the quotient is cents.

Examples.

1. Reduce £3 10*s.* 11½*d.* to dol. &c.

35·00
·48

35·48÷3=$11·826† *Ans.*

2. Reduce £17 19*s.* 11¾*d.* to dol. &c.

179·50
·49

179·99÷3=$59·999† *Ans.*

CONTRA.

To change dolls. cts, &c. to the former currency of New-Hampshire, Vermont, Massachusetts, Rhode-Island and Connecticut.

Rule. When the sum to be reduced is dollars; multiply the dollars by 3; double the right hand figure of the product for shillings; the remaining figures are pounds. If the sum to be reduced is dolls. cents and mills, multiply the whole by 3, point off 4 figures from the right for decimals; the rest of the product is pounds; (note, if mills are not named in the sum, three figures only must be pointed off;) find the value of the decimal part by multiplying by 20, 12 and 4; observing to point off for decimals each time of multiplying; and the sums standing on the left of the separatrix will be shillings pence and farthings.

Examples.

1. Reduce $251 to lawful money.
251×3=£75 6*s.* *Ans.*

2. Reduce $9529 to lawful money.
9529×3=£2858 14*s.* *Ans.*

3. Reduce $192 to lawful money.
192×3=£57 12*s.* *Ans.*

4. Reduce $999 to lawful money.
£299 14*s.* *Ans.*

1. Reduce $99·67 cts. to lawful money.

99·67
3
29·901
20
18·020
12
·240 £29 18*s.* $\frac{24}{100}$ *Ans.*

2. Reduce $67·90 to lawful money.

Ans. £20 7*s.* 4¾*d.*

3. Reduce $99·999 to lawful money.

$99.999
3
29·9997
20
19.9940
12
11·9280
4
3·9120 *Ans.* £29 19*s.* 11*d.*¾†

4. Reduce $61·276 to lawful money.

Ans. £18 7*s.* 7¾*d.*†

To reduce the former currency of New-York and North-Carolina to dolls. cts. &c. and the contrary.

Rule. Prepare the sum to be reduced exactly as in New-Hampshire, Massachusetts, &c. and divide by 4 instead of 3, the quotient is cents.

N. B. One dollar is equal to 8 shillings.

Examples.

1. Reduce £9 16*s*. to dollars, &c.

98 ÷ 4 = $24·50 *Ans.*

2. Reduce £230 10*s*. to dollars, &c.

2305 ÷ 4 = $576·25 *Ans.*

3. Reduce £219 15*s*. 4¼*d*. to dollars, cents, &c.

2197·50

·18

2197·68 ÷ 4 = $524·42 *Ans.*

4. Reduce £419 10*s*. to dollars, cents, &c.

$1049·75 *Ans.*

CONTRA.

Change dollars, &c. to New-York and North Carolina currency.

Rule. Proceed as in New-Hampshire currency, &c. only multiply by 4 instead of 3.

Examples.

1. Change 842 dollars to New-York currency, &c.

842

4

£336 16*s*. *Ans.*

2. Change $114·25 to North-Carolina currency &c.

114·25

4

45·700

20

14·000 £45 14*s*. *Ans.*

New-Jersey, Delaware, Pennsylvania, and Maryland currencies reduced to the present currency of the United States, and the contrary.

N. B. One dollar equal to 7*s*. 6*d*. in these states.

Rule. Multiply the given sum (if it is pounds only,) by 8, and divide the product by 3; the quotient is dollars. If the sum is pounds, shillings and pence, reduce the whole to pence, and add one ninth of the whole to itself, the sum will be cents.

Examples.

1. Reduce £942 to dollars, &c.

942
8
———
3)7536
———
$2512 *Ans.*

2. Reduce £961 19*s*. 6*d*. to dollars, &c.

£ *s*. *d*.
961 19 6
20
———
19239
12
———
9)230878
25653$\frac{1}{9}$
———
$2565·31 cts. *Ans.*

CONTRA.

Reduce dollars, &c. to the former currency of New-Jersey, Delaware, Pennsylvania and Maryland.

Rule. If the sum is dollars only; multiply by 3, and divide by 8; the quotient is pounds; if the sum is dollars and cents, subtract one tenth of the whole sum from itself, the remainder is pence.

1. Reduce 628 dollars to Delaware currency, &c.
628 × 3 ÷ 8 = £235 10*s*. *Ans*.

2. Reduce 2512 dollars to New-Jersey currency.
Ans. £942.

3. Reduce $2565·20 to Maryland currency, &c.

$\frac{1}{10}$)2565·20
256·52 subtract.

12)230868

20)19239

£961 19*s*. *Ans*.

South-Carolina and Georgia currency reduced to dolls. and cts. and the contrary.

Rule. If the sum to be reduced is pounds, multiply by 30, and divide by 7, the quotient is dollars; (a dollar in South Carolina is equal to 4*s*. 8*d*. or seven thirtieths of a pound); if there are shillings and pence, &c. reduce the whole to pence, annex two cyphers and divide by 56, the quotient is cents.

Examples.

1. Reduce £56 to dollars, &c.

£56
30

7)1680

$240 *Ans*.

2. Reduce £21 to dollars, &c. *Ans*. $90.

3. Reduce £22 9*s.* 4*d.* to dollars, &c.

```
£   s.  d.
22  9   4
 20
 ---
449
 12
 ---
5392·00÷56=$96·28 4/7 Ans.
```

CONTRA.

Dollars, &c. reduced to Georgia, and South-Carolina currency.

RULE. Multiply dollars by 7, and divide by 30, the quotient is pounds.

If there are cents in the sum, multiply by 56, reject two figures from the right of the product, the rest of the figures are pence.

Examples.

1. Reduce $240 to Georgia currency, &c.
240×7÷30=£56 *Ans.*

2. Reduce $90 to South-Carolina currency, &c.
90×7÷30=£21 *Ans.*

3. Reduce $96·28 $\frac{4}{7}$ to Georgia currency.

```
    96·28 4/7
       56
    -----
    57768
   48140
       72
   ------
12)5392·40
   ------
    449s.4d.=£22 9s. 4d. Ans.
```

To reduce Canada and Nova Scotia currency to the present currency of the United States, and the contrary.

Rule. When the sum to be reduced is pounds; multiply by 4, the product is dollars, (1 dol. is equal to 5 shillings in Canada, &c.); if shillings and pence are in the sum, reduce the whole to pence, annex 2 cyphers, and divide by 60, (note, 60 pence are equal to a dol.) the quotient is cents.

Examples.

1. Reduce £108 to dollars.

108×4=$432 *Ans.*

2. Reduce £121 to dollars.

121×4=$484 *Ans.*

3. Reduce £1057 5 shil. Canada currency, to dollars, &c.

```
1057 5
    20
------
 21145
    12
--------
253740·00÷60=$4229.00 Ans.
```

CONTRA.

Dollars, &c. reduced to the currency of Canada and Nova-Scotia.

Rule. If the sum to be reduced is dollars, divide them by 4, the quotient is pounds; if there are dol- and cts. multiply by 60, rejecting two figures on the right, the product is pence.

Examples.

1. Reduce $432 to Canada currency, &c.

432÷4=£108 *Ans.*

2. Reduce $484 to Canada currency, &c.

484÷4=£121 *Ans.*

3. Reduce $4229.20 to Canada currency, &c.

```
   422920
       60
 ————————
12)253752|00
 ————————
    21146÷20=£1057 6s. Ans.
```

* * *

MONIES OF THE WORLD.

The following Tables exhibit the monies of account, and pieces of coin in the known world, and their intrinsic value in dollars, cents and mills, and parts of mills; calculated on the principle of allowing £1 sterling to be equal to $4·44 cts. in the United States; the rate at which £1 sterling is estimated by the United States laws.

NOTE. No labour has been spared by the Author in consulting books on exchange; and among the numerous volumes he has consulted, the SHIP MASTER'S DAILY ASSISTANT has furnished the following extracts; and it is upon the authority of that book, that the following Tables are published; in that book the Tables express the English intrinsic, or sterling value of each denomination of foreign money, both real and imaginary: and in the following Tables, the intrinsic value of each denomination of foreign money is expressed in dollars, cents, mills and parts of mills.

N. B. This mark * is fixed to imaginary money, or money of account.

Northern parts of Europe.

							D. cts. m.
ENGLAND. *London, Bristol, Edinburgh, &c.*	*4	farthings	equal	*1	penny	equal	0·01·8$\frac{1}{2}$
	12	pence	"	*1	shilling	"	·22·2
	20	shillings	"	*1	pound	"	4·44·0
	5	shillings	"	1	crown	"	1·11·0
	21	shillings	"	1	guinea	"	4·66·2
	4	pence	"	1	groat	"	·07·4
	6	pence	"		half a shil.	"	·11·1
Isle of Man, *Castletown, &c.*	*4	farthings	equal	*1	penny	equal	0·01.5$\frac{6}{7}$
	12	pence	"	*1	shilling	"	·19·0$\frac{2}{7}$
	20	shillings	"	*1	pound	"	3.80.6$\frac{8}{14}$
	14	pence	"	1	shilling	"	·22·2
	70	pence	"	1	crown	"	1·11·0
	24$\frac{1}{2}$	shillings	"	1	guinea	"	4·16·2
IRELAND. *Dublin, Cork, Londonderry, &c.*	*4	farthings	equal	*1	penny	equal	0·01·7$\frac{1}{13}$
	12	pence	"	*1	shilling	"	·20·4$\frac{71}{80}$
	20	shillings	"	*1	pound Irish	"	4·09·7$\frac{3}{4}$
	13	pence	"	1	shilling	"	·22.2
	65	pence	"	1	crown	"	1·11.
	22$\frac{3}{4}$	shillings	"	1	guinea	"	4·66·2
FLANDERS. *Ghent, Ostend, Antwerp, &c.*	*8	pennings	equal	1	grot	equal	0·00·8$\frac{13}{40}$
	2	grots	"	1	petard	"	·01·6$\frac{13}{20}$
	6	petards	"	*1	scalin	"	·09·9$\frac{9}{10}$
	40	grots	"	*1	florin	"	·33·3
	17$\frac{1}{2}$	scalins	"	1	ducat	"	2·05·3$\frac{1}{2}$
	210	grots	"	*1	pound flemish		1·99.8
HOLLAND. *Amsterdam, Rotterdam, &c.*	*8	pennings	equal	*1	grot	equal	0·00.9$\frac{57}{80}$
	2	grots	"	1	stiver	"	·01·9$\frac{17}{40}$
	6	stivers	"	1	scalin	"	·11.6$\frac{11}{20}$
	20	stivers	"	1	guilder	"	·38·8$\frac{1}{2}$
	50	stivers	"	1	rix dollar	"	·96·6$\frac{5}{8}$
	105	stivers	"	1	ducat	"	2·05·3$\frac{1}{2}$
	60	stivers	"	1	dry guilder	"	1·16·5$\frac{1}{2}$
	6	guilders	"	*1	pound flemish		2·33·1

Northern parts of Europe.

							D. cts. m.
GERMANY. *Hamburgh, Altena, Lubeck, Bremen, &c.*	2	trylings	equal	*1	sexling	equal	0·00·0$\frac{1}{128}$
	2	sexlings	"	1	fenning	"	·00·1$\frac{47}{64}$
	12	fennings	"	1	shilling lubs	"	·02·0$\frac{13}{16}$
	16	shillings	"	*1	mark	"	·33·3
	2	marks	"	1	slet dollar	"	·66·6
	3	marks	"	1	rix dollar	"	·99.9
	6$\frac{1}{4}$	marks	"	1	ducat	"	2·08·1$\frac{1}{4}$
	120	shillings	"	1	pound flemish		2·55·3
Hanover, Zell, Lunenburgh, &c.	3	fennings	equal	1	dreyer	equal	0·00.8$\frac{3}{32}$
	8	fennings	"	1	marien	"	·02·1$\frac{7}{12}$
	12	fennings	"	1	grosh	"	·03·2$\frac{3}{8}$
	8	groshen	"	1	half goulder	"	·25.9
	16	groshen	"	1	gulden	"	·51·8
	24	groshen	"	*1	rix dollar	"	·77·7
	4	guldens	"	1	ducat	"	2·03·5
Saxony, Holstein Dresden, Leipsic, &c.	2	hellers	equal	1	fening	equal	0·00·2$\frac{67}{96}$
	6	hellers	"	1	dreyer	"	·00·8$\frac{3}{32}$
	16	hellers	"	1	marien	"	·02·1$\frac{7}{12}$
	12	fennings	"	1	grosh	"	·03·2$\frac{3}{8}$
	16	groshen	"	1	gould	"	·51·8
	24	groshen	"	*1	rix dollar	"	·77·7
	32	groshen	"	1	specie dol.	"	1·03·6
	4	goulds	"	1	ducat	"	2·07·2
Brandenburg, Berlin, Pomerania, Stettin, &c.	*9	deniers	equal	1	polchen	equal	0·00·4$\frac{19}{60}$
	18	deniers	"	1	grosh	"	·00·8$\frac{19}{30}$
	3	polchens	"	1	abrass	"	·01·2$\frac{19}{20}$
	20	groshen	"	*1	mark	"	·17·2$\frac{2}{3}$
	30	groshen	"	1	floren	"	·25·9
	90	groshen	"	*1	rix dollar	"	·77·7
	108	groshen	"	1	albertus	"	·92·5
	8	florens	"	1	ducat	"	2·07·2

Northern parts of Europe.

					D. cts. m.
GERMANY. Cologne, Mentz, Munich, Munster, &c.	3 dutes	equal	1 cruitzer	equal	0·00·4$\frac{137}{160}$
	2 cruitzers	“	1 albus	“	·00·9$\frac{57}{80}$
	8 dutes	“	1 stiver	“	·00·1$\frac{17}{20}$
	3 stivers	“	1 plapert	“	·03·8$\frac{17}{20}$
	4 plaperts	“	1 copstuck	“	·15·4$\frac{4}{10}$
	40 stivers	“	1 guilder	“	·51·8
	2 guilders	“	1 hard doll.	“	1·03·6
	4 guilders	“	1 ducat	“	2·05·3$\frac{1}{2}$

Bohemia, Silesia, Hungary, Prague, &c.	2 fenings	equal	1 dreyer	equal	0·00·4$\frac{19}{60}$
	3 fenings	“	1 grosh	“	·00·6$\frac{19}{40}$
	4 fenings	“	1 cruitzer	“	·00·8$\frac{19}{30}$
	2 cruitzers	“	1 white grosh	“	·01·7$\frac{8}{30}$
	60 cruitzers	“	1 gould	“	·51·8
	90 cruitzers	“	*1 rix-doll.	“	·77·7
	2 goulds	“	1 hard doll.	“	1·03·6
	4 goulds	“	1 ducat	“	2·07·2

Austria, Swabia, Vienna Trieste, &c.	3 fenings	equal	1 dreyer	equal	0·00·4$\frac{19}{60}$
	4 fenings	“	1 cruitzer	“	·00·8$\frac{19}{30}$
	14 fenings	“	1 grosh	“	·02·4$\frac{1}{3}$
	4 cruitzers	“	1 batzen	“	·03·3$\frac{17}{32}$
	15 batzens	“	1 gould	“	·51·8.
	90 cruitzers	“	*1 rix dollar	“	·77·7.
	30 batzens	“	1 specie doll.	“	1·03·6.
	60 batzens	“	1 ducat	“	2·07·2.

Franconia, Frankfort, Nuremberg, &c.	4 fenings	equal	1 cruitzer	equal	0·00·8$\frac{19}{30}$
	3 cruitzers	“	1 keyser grosh	“	·02·5$\frac{9}{10}$
	4 cruitzers	“	1 batzen	“	·03·4$\frac{8}{18}$
	15 cruitzers	“	1 ort gould	“	·12·9$\frac{1}{2}$
	60 cruitzers	“	1 gould	“	·51·8
	90 cruitzers	“	*1 rix dollar	“	·77·7
	2 goulds	“	1 hard doll.	“	1·03·6
	240 cruitzers	“	1 ducat	“	2·07·2

Nothern parts of Europe.

					D. cts. m.
POLAND & PRUSIA. Cracow, Warsaw, Koninsberg, &c.	3 shelons	equal	1 grosh	equal	0·00·8 19/30
	5 groshen	“	1 coustic	“	·04·6¼
	3 coustics	“	1 tinse	“	·12·9½
	18 groshen	“	1 ort	“	·15·5⅖
	30 groshen	“	1 florin	“	·25·9
	90 groshen	“	*1 rix-doll.	“	·77·7
	8 florins	“	1 ducat	“	2·03·5
	5 rix doll.	“	1 frederic d'or	“	3·77·4
LIVONIA. Riga, Revel, Narva, &c.	6 blackens	equal	1 grosh	equal	0·00·8 19/30
	9 blackens	“	1 vorden	“	·01·2 19/20
	2 groshen	“	1 whiten	“	·01·7 4/15
	6 groshen	“	1 marc	“	·05·1⅘
	20 groshen	“	1 florin	“	·25·9
	30 groshen	“	*1 rix-doll.	“	·77·7
	108 groshen	“	1 albertus	“	·92·5
	64 whitens	“	1 copper pl.dol.	“	1·11·0
DENMARK & NORWAY. Copenhagen, Berghen, Drontheim, &c.	6 skillings	equal	1 druggen	equal	0·06·2 7/16
	16 skillings	“	*1 marc	“	·16·6½
	20 skillings	“	1 rix-marc	“	·20·8⅛
	24 skillings	“	1 rix-ort	“	·24·9
	4 marcs	“	1 crown	“	·66·6
	6 marcs	“	1 rix-dol.	“	·99·9
	11 marcs	“	1 ducat	“	1·83·2½
	14 marcs	“	1 hat-ducat	“	2·33·1
SWEDEN & LAPLAND. Upsal, Thorn, Stockholm, &c.	*2 runstics	equal	1 stiver	equal	0·00·7 7/36
	8 runstcs	“	1 copper marc	“	·02·8 7/9
	3 copper marcs	“	1 silver do.	“	·08·6⅓
	4 copper do.	“	1 copper dol.	“	·11·5 1/9
	9 copper do.	“	1 caroline	“	·25·9
	3 copper dol.	“	1 silver dol.	“	·34·5⅓
	3 silver do.	“	1 rix do.	“	1·03·6
	2 rix do.	“	1 ducat	“	2·05·3½

Northern parts of Europe.

					D. cts. m.
RUSSIA & MUSCOVY. *Moscow, Petersburg, Archangel, &c.*	2 poluscas	equal	1 denusca	equal	0·00·4$\frac{199}{200}$
	2 denuscas	“	1 copec	“	·09·0$\frac{99}{100}$
	3 copecs	“	1 altin	“	·01·1$\frac{47}{100}$
	10 copecs	“	1 grievener	“	·09·9†
	25 copecs	“	1 polpotin	“	.24·9$\frac{3}{4}$
	50 popecs	“	1 poltin	“	·49·9$\frac{1}{2}$
	100 copecs	“	1 ruble	“	·99·9
	2 rubles	“	1 xervonitz	“	1·99·8

Southern parts of Europe.

SWITZERLAND. *Bazil, Zurich, Zug, &c. &c.*	3 rapen	equal	1 fening	equal	0.00·2†
	4 fenings	“	1 cruitzer	“	·00·9†
	12 fenings	“	*1 sol	“	·02.7$\frac{3}{4}$
	15 fenings	“	1 coarse batzen“		.03·4†
	18 fenings	“	1 good batzen	“	·04.1$\frac{5}{8}$
	20 sols	“	*1 livre	“	·55·5
	60 cruitzers	“	1 gulden	“	·55·5
	108 cruitxers	“	1 rix-dol.	“	·99·9

St. Gaul, Appensel, &c.	2 hellers	equal	1 fenning	equal	0·00·2$\frac{5}{16}$
	4 fenings	“	1 cruitzer	“	·00·9$\frac{1}{4}$
	12 fenings	“	*1 sol	“	·02·7$\frac{3}{4}$
	4 cruitzers	“	1 course batzen		·03·4†
	5 cruitzers	“	1 good batzen	“	·04·1$\frac{5}{8}$
	20 sols	“	1 livre	“	·55·5
	202 cruitzers	“	1 rix dollar	“	·94·3$\frac{1}{2}$

Bern, Luzerne, Neufchatel, &c.	4 deniers	equal	1 cruitzer	equal	0·00·7$\frac{2}{5}$
	3 cruitzers	“	*1 sol	“	·02·2†
	4 cruitzers	“	1 plapert	“	·02·9$\frac{3}{5}$
	5 cruitzers	“	1 gros	“	·03·7
	6 cruitzers	“	1 batzen	“	·04·4$\frac{2}{5}$
	20 sols	“	*1 livre	“	·44·4
	75 cruitzers	“	1 gulden	“	·55·5
	135 cruitzers	“	1 crown	“	·99·9

Southern parts of Europe.

SWITZERLAND. *Geneva, Peckay, Bonne, &c.*

						D. cts. m.
2	deniers	equal	1	denier cur.	=	0·00·1$\frac{5}{32}$
12	deniers	"	1	small sol	"	·00·6†
12	deniers cur.	"	1	sol current	"	·01·3$\frac{7}{8}$
12	small sols	"	*1	florin	"	·08·3$\frac{1}{4}$
20	sols current	"	*1	livre cur.	"	·27·7$\frac{1}{2}$
10$\frac{1}{2}$	florins	"	1	pacaton	"	·38·3†
15$\frac{3}{4}$	florins	"	1	croisade	"	1·31·1$\frac{1}{16}$
24	florins	"	1	ducat	"	1·99·8

FRANCE & NAVARRE, *Lisle, Cambry, Valenciennes, &c.*

12	deniers	equal	1	sol	equal	0·00·9$\frac{1}{4}$
15	deniers	"	1	petard	"	·01·1$\frac{9}{16}$
15	petards	"	*1	piette	"	·17·3$\frac{7}{16}$
20	sols	"	*1	livre tournois		·18·5
20	petards	"	*1	florin	"	·23·1$\frac{1}{4}$
60	sols	"	1	ecu of exch.	"	·55·5
10$\frac{1}{2}$	livres	"	1	ducat	"	2·05·3$\frac{1}{2}$
24	livres	"	1	louis d'or	"	4·44·

Dunkirk, St. Omers, St. Quintin, &c.

12	deniers	equal	1	sol	equal	0·00·9$\frac{1}{4}$
15	deniers	"	*1	petard	"	·01·1$\frac{9}{16}$
15	sols	"	*1	piette	"	·13·8$\frac{3}{4}$
20	sols	"	*1	livre tour.	"	·18·5
3	livres	"	1	ecu of ex.	"	·55·5
24	livres	"	1	guinea	"	4·66·2
39$\frac{1}{8}$	livers	"	1	moeda	"	5·99·8

Paris, Lyons, Bayonne, Marseilles, Bourdeaux.

3	deniers	equal	1	liard	equal	0·00·2$\frac{5}{16}$
2	liards	"	1	dardene	"	·00·4$\frac{5}{8}$
12	deniers	"	1	sol	"	·00·9$\frac{1}{4}$
20	sols	"	*1	livre tournois		·18·5
60	sols	"	1	ecu of ex.	"	·55·5
6	livres	"	1	ecu	"	1·11·
10	livres	"	*1	pistole	"	1·85·1
24	livres	"	1	louis d'or	"	4·44·

Southern parts of Europe.

							D. cts. m.
PORTUGAL. *Lisbon, Oporto, &c.*	10	rez	equal	1	half-vintin	=	0·01·2$\frac{39}{80}$
	20	rez	“	1	vinten	“	·02·4$\frac{39}{40}$
	5	vintins	“	1	testoon	“	·12·4$\frac{7}{8}$
	4	testoons	“	1	crusade of ex.		·49·9†
	24	vintins	“	1	new crusade	“	·59·9$\frac{2}{5}$
	10	testoons	“	*1	milre	“	1·24·8$\frac{3}{4}$
	48	testoons	“	1	moeda	“	5·99·4
	64	testoons	“	1	joanese	“	7·99·2
SPAIN & CATALONIA. *Madrid, Seville and New Plate, &c.*	*2	maravedies	equal	1	quartil	equal	0·00·5$\frac{231}{272}$
	34	maravedes	“	1	rial	“	·09·9$\frac{7}{16}$
	2	rials	“	1	pistarine	“	·19·8$\frac{7}{8}$
	8	rials	“	*1	piastre of ex.		·79·5$\frac{1}{2}$
	10	rials	“	1	dollar	“	·99·9
	375	maravedies	“	*1	ducat of ex.		1·10·0$\frac{3}{4}$
	32	rials	“	*1	pistole of ex.		3·18·2
	36	rials	“	1	pistole	“	3·55.2
Gibraltar, Malaga, Denia Velon, &c.	*2	maravedies	=	1	ochavo	=	0·00·2$\frac{503}{544}$
	4	maravedies	“	1	quartil	“	·00·5$\frac{231}{272}$
	34	maravedies	“	*1	rial velon	“	·05·3$\frac{3}{16}$
	15	rials	“	1	piastre of ex.		·79·5$\frac{1}{2}$
	512	maravedies	“	1	piastre	“	·79·5†
	60	rials	“	*1	pistole of ex.		3·18·2
	2048	maravedies	“	*1	pistole of ex.		3·18·2
	70	rials	“	1	pistole	“	3·71·8†
Barcelona, Saragossa Valencia, Old Plate, &c.	10	maravedies	=	1	soldo	=	0·06·2$\frac{7}{16}$
	2	soldos	“	1	rial, old plate		·12·4$\frac{7}{8}$
	20	soldos	“	*1	libra	“	1·24·8$\frac{3}{4}$
	24	soldos	“	*1	ducat	“	1:49·8$\frac{1}{2}$
	16	soldos	“	*1	dollar	“	·99·9
	22	soldos	“	*1	ducat	“	1·37·3$\frac{5}{8}$
	21	soldos	“	1	ducat	“	1·31·1$\frac{3}{16}$
	60	soldos	“	1	pistole	“	3·71·8$\frac{1}{2}$

Southern parts of Europe.

						D. cts: m.
ITALY. Genoa, Novi, St. Remo, Corsica, Bastia, &c.	12 denari	equal	1 soldi	equal	0·00·7†
	4 soldi	"	1 chevalet	"	·03·1†
	20 soldi	"	*1 lire	"	·15·9†
	30 soldi	"	1 testoon	"	·23·3†
	5 lires	"	1 croisade	"	·79·5½
	115 soldi	"	*1 pezzo of ex.		·92·5
	6 testoons	"	1 genouine	"	1·37·6½
	20 lires	"	1 pistole	"	3·18·2
Piedmont, Savoy, Turin, Sardinia, Camberry, &c.	3 denari	equal	1 quatrini	equal	0·00·3†
	12 denari	"	1 soldi	"	·01·3⅞
	12 soldi	"	*1 florin	"	·16·6½
	20 soldi	"	*1 lire	"	·27·7½
	6 florins	"	1 scudi	"	·99·9
	7 florins	"	1 ducatoon	"	1·16·5†
	13 lires	"	1 pistole	"	3·60·7†
	16 lires	"	1 louis d'or	"	4·44
Milan, Modena, Parma, Pavia, &c.	3 denari	equal	1 quatrini	equal	0·00·2 5/164
	12 denari	"	1 soldi	"	·00·8 10/82
	20 soldi	"	*1 lire	"	·16·2 36/82
	115 soldi	"	1 scudi current.		·92·7 5/16
	117 soldi	"	*1 scudi of ex.	"	·94·3½
	6 lires	"	1 philip	"	·67·1¼
	22 lires	"	1 pistole	"	3·55·2
	23 lires	"	1 spanish pist.		3·71·8†
Leghorn and Florence, &c.	4 denari	equal	1 quatrini	equal	0·00·3 5/80
	12 denari	"	1 soldi	"	·00·7†
	5 quatrini	"	1 craca	"	·01·2†
	8 cracas	"	1 quilo	"	·10·2 7/9
	20 soldi	"	*1 lire	"	·15·4†
	6 lires	"	1 piastre of ex.		·92·5
	7½ lires	"	1 ducat	"	1·15·6¼
	22 lires	"	1 pistole	"	3·44·1

Southern parts of Europe.

							D. cts. m.
ITALY, Rome, Vecchia, Civita. Ancona, &c.	5	quatrini	equal	1	bayoc	equal	0·01·3$\frac{7}{8}$
	8	bayocs	"	1	julio	"	·11·1
	10	bayocs	"	1	stamped julio		·13·8$\frac{1}{4}$
	24	bayocs	"	1	testoon	"	·33·3
	10	julios	"	1	crown current		1·11·
	12	julios	"	*1	do. stamped		1·33·2
	18	julios	"	1	chequin	"	1·99·8
	31	julios	"	1	pistole	"	3·44·1

Naples, Gaieta, Capua, &c.	3	quatrini	equal	1	grain	equal	0·00·7$\frac{3}{8}$
	10	grains	"	1	car in	"	·07·4
	40	quatrini	"	1	paulo	"	·09·8$\frac{4}{8}$
	20	grains	"	1	tarin	"	·14·8
	40	grains	"	1	testoon	"	·29·6
	100	grains	"	1	ducat ex.	"	·74·
	23	tarins	"	1	pistole	"	3·40·4
	25	tarins	"	1	spanish pist.		3·71·8$\frac{1}{2}$

Sicily Malta, Palermo, Messina.	6	pichili	equal	1	grain	equal	0·00·2†
	8	pichili	"	1	ponti	"	·00·4†
	10	grains	"	1	carlin	"	·02·8†
	20	grains	"	1	tarin	"	·05·6†
	6	tarins	"	1	florin of ex.	"	·34·1†
	13	tarins	"	*1	ducat of ex.		·74·0
	60	carlins	"	1	ounce	"	1·70·7†
	2	ounces	"	1	pistole	"	3·40·4

Bologna, Ravenna, &c.	6	quatrini	equal	1	bayoc	equal	0·01·1$\frac{1}{10}$
	10	bayocs	"	1	julio	"	·11·1
	20	bayocs	"	1	lire	"	·22·2
	3	julios	"	1	testoon	"	·33·3
	85	bayocs	"	1	scudi of exch.	"	·94·3$\frac{1}{2}$
	105	bayocs	"	1	ducatoon	"	1·16·5$\frac{1}{2}$
	100	bayocs	"	1	crown	"	1·11·0
	31	julios	"	1	pistole	"	3·44·1

					D. cts. m.
ITALY. Venice, Bergham, &c.	12 picoli	equal	1 soldi	equal	·00·3†
	6½ soldi	"	*1 gros	"	·04·0†
	18 soldi	"	1 jule	"	·11·1
	20 soldi	"	*1 lire	"	·11·7$\frac{2}{12}$
	3 jules	"	1 testoon	"	·33·3
	124 soldi	"	1 ducat cur.	"	·76·7¾
	24 gros	"	*1 ducat of ex.	"	·96·2
	17 lires	"	1 chequin	"	2·08·5

TURKEY. Morea, Candia, Cyprus, &c.	4 mangars	=	*1 asper	equal	0·00·7⅖
	3 aspers	"	1 parac	"	·03·3†
	5 aspers	"	1 bestic	"	·05·5†
	10 aspers	"	1 ostic	"	·11·1
	20 aspers	"	1 solota	"	·22·2
	80 aspers	"	*1 piastre	"	·88·8
	100 aspers	"	1 caragrough	"	1·11·0
	10 solotas	"	1 xeriff	"	2·22·0

Asia.

ASIA. ARABIA. Medina, Mecca, Mocha, &c.	5¼ carrets	equal	1 caveer	equal	0·01·2$\frac{295}{400}$
	7 carrets	"	1 comashee	"	·01.6†
	80 carrets	"	1 larin	"	·18·7†
	18 comashees	"	1 abyss	"	·29·9†
	60 comashees	"	*1 piastre	"	·99·9
	80 caveers	"	1 dollar	"	·99·9
	100 comashees	"	1 sequin	"	1·66·5
	80 larins	"	*1 tomond	"	14·98·5

PERSIA. Ispahan, Ormus, Gombrun, &c.	4 coz	equal	1 bisti	equal	0·02·9⅗
	10 coz	"	1 shahee	"	·07·4
	20 coz	"	1 mamooda	"	·14·8
	25 coz	"	1 larin	"	·18·5
	24 shahees	"	1 abashee	"	·29·6
	5 abashees	"	1 or	"	1·48·0
	12 abashees	"	1 bovello	"	3·55·2
	50 abashees	"	*1 tomond	"	14·80·

Asia.

							D. cts. m.
MOGUL. *Gussurut, Surat, Cambay, &c.*	2	peckas	equal	1	pice	equal	0·00·7$\frac{47}{74}$
	4	piecs	"	1	fanam	"	·03·4†
	5	pices	"	1	viz	"	·04·3$\frac{23}{64}$
	16	pices	"	1	ana	"	·13·8$\frac{3}{4}$
	4	anas	"	1	rupee	"	·55·5
	2	rupees	"	1	Eng. crown		1·11·0
	14	anas	"	1	pagoda	"	1·94·3†
	4	pagodas	"	1	gold rupee	"	7·77·0

Malabar, Bombay, Dabul, &c.	*2	budgrooks	=	1	re	equal	0·00·1$\frac{122}{800}$
	5	rez	"	1	pice	"	·00·6$\frac{39}{880}$
	16	pices	"	1	laree	"	·09·9$\frac{9}{10}$
	20	pices	"	1	quarter	"	·12·4$\frac{7}{8}$
	240	rez	"	1	xeraphim	"	·29·9†
	4	quarters	"	1	rupee	"	·49.9†
	14	quarters	"	1	pagoda	"	1·77·7
	60	quarters	"	1	gold rupee	"	7·77·0

Corromandel, Madrass, &c.	5	cash	equal	1	viz	equal	0·00·3†
	2	viz	"	1	pice	"	·00·6†
	6	pices	"	1	pical	"	·04·1$\frac{5}{8}$
	8	pices	"	1	fanam	"	·05·5†
	10	fanams	"	1	rupee	"	·55·5
	2	rupees	"	1	Eng. crown		1.11·0
	36	fanams	"	1	pagoda	"	1·94·3†
	4	pagodas	"	1	gold rupee	"	7·77·0

SIAM. *Pegu, Malacca, Cambodia, Sumatra, &c.*	800	cori	equal	1	fettee	equal	0·00·3†
	125	fettees	"	1	salteleer	"	·13·8†
	250	fettees	"	1	sooco	"	·29·6
	500	fettees	"	1	tutal	"	·55·5
	1000	fettees	"	1	dollar	"	·99·9
	2	ticals	"	1	rial	"	1·11·0
	4	soocos	"	1	ecu	"	1·11·0
	8	salteleers	"	1	crown	"	1·11·0

Asia.

						D. cts. m.
CHINA. *Pekin, Canton, &c.*	10 caxa	equal	1	candareen	equal	0·01·4⅘
	10 candareens		1	mace	"	·14·8
	35 candareens		1	rupee	"	·55·5
	2 rupees	"	1	dollar	"	·99·9
	70 candareens		1	rix-dollar	"	·97·1¼
	70 maces	"	1	ecu	"	1·11·0
	2 rupees	"	1	crown	"	1·11·0
	10 maces	"	*1	tale	"	1·48·0
JAPAN. *Jeddo, Mecco, &c.*	20 pitis	equal	1	mace	equal	0·07·4
	15 maces	"	1	oz. silver	"	1[illegible]7·9†
	20 maces	"	1	tale	"	1·48
	30 maces	"	1	ingot	"	2·19·8†
	13 oz. silver	"	1	oz. of gold	"	13·98·6
	2 oz. gold	"	1	japanese	"	27·97·2
	2 japaneses	"	1	double	"	55·94·4
	21 oz. gold	"	1	cattee	"	293·70·6
AFRICA. *Egypt, Cairo, Sayde, Alexandria, &c.*	3 aspers	equal	1	medin	equal	0·03·0†
	24 medins	"	1	Italian ducat	"	·74·0
	80 aspers	"	*1	piastre	"	·88·8
	30 medins	"	1	dollar	"	·99·9
	96 aspers	"	1	ecu	"	1·11·0
	32 medins	"	1	crown	"	1·11·0
	200 aspers	"	1	sultanin	"	2·22·0
	70 medins	"	*1	pargo doll.	"	2·33·1
BARBARY. *Algiers, Tunis, Tripoly, Una, &c.*	3 aspers	equal	1	medin	equal	0·03·0†
	10 aspers	"	1	rial, old plate	"	·12·3†
	3 rials	"	1	double	"	·24·9¾
	4 doubles	"	1	dollar	"	·99·9
	24 medins	"	1	silv. chequin	"	·74·0
	30 medins	"	1	dollar	"	·99·9
	180 aspers	"	1	xequin	"	1·96·2
	15 doubles	"	1	pistole	"	3·71·8†

					D. cts. m.
MOROCCO, *Santa-Cruz, Fez, Tangiers, Sallee, &c.*	24 fluces	equal	1 blanquil	equal	0·03·7
	4 blanquils	"	1 ounce	"	·14·8
	7 blanquils	"	1 octavo	"	·25·9
	14 blanquils	"	1 quarto	"	·51·8
	2 quartos	"	1 medio	"	1·03·6
	28 blanquils	"	1 dollar	"	·99·9
	54 blanquils	"	1 xequin	"	1·99·8
	100 blanquils	"	1 pistole	"	3·71·8½

America, W. I.

AMERICA. *English West Indies. Jamaica, Barbadoes, &c.*	2 half pence	equal	*1 penny	equal	0·01·3†
	7½ pence	"	1 bitt	"	·09·9†
	12 pence	"	*1 shilling	"	·15·9$\frac{4}{40}$
	75 pence	"	1 dollar	"	·99·9
	7 shillings	"	1 crown	"	1·11·0
	20 shillings	"	*1 pound	"	3·16·3†
	24 shillings	"	1 pistole	"	3·71·8†
	30 shillings	"	1 guinea	"	4·66·2

French West Indies. St. Domingo, Martinico.	*2 half sols	equal	1 sol	equal	0·00·6†
	7½ half sols	"	1 half sealin	"	·04·9†
	15 sols	"	1 scalin	"	·09·9†
	20 sols	"	*1 livre	"	·14·2$\frac{5}{7}$
	7 livres	"	1 dollar	"	·99·9
	8 livres	"	1 ecu	"	1·08·2¼
	26 livres	"	1 pistole	"	3·55·2
	32 shillings	"	1 louis d'or	"	4·44

Use of the preceding Tables.

The value of any denomination of foreign money being known in dollars, cents, &c. the value of any number of that denomination may be found by single proportion, or by multiplication.

Examples.

1. What is the value of 29 shillings sterling, in dol. cts. &c. one shilling sterling being estimated at ·22 cts. 2 m. ?

s. *cts. m.* *s.* *cts. m.*
as 1 : ·22·2 : : 29 : $6.43· 8 Ans.
·222 × 29 = 6·43· 8 Ans.

2. A ship and cargo were sold in England for £1500 15 s. sterling; what is the value in dol. &c. in America ?

£ *D. cts.* *£* *s.* *D. cts.*
as 1 : 4·44 : : 1500 15 : 6663·33 Ans.

3. What is the value of a cargo of coffee, (in dollars, &c. of America,) which was sold in China for 6000 tales; the tale of china being estimated at $1·48 cts. ? Ans $8880.

4. What is the value of a cargo of coffee, in sterling money, which was sold in China for 6000 tales ?

Note. Reduce the tales to American money; and then say if $4·44 in America, is equal to £1 sterling, so is $8880, in America to £2000 sterling Ans.

5. A merchant bought 2646 lbs. of coffee in St. Domingo, for 1 livre per lb.; and sold it in Boston for ·24 cts. per lb.; pay'd freight ·02 cts. per lb.; and duties ·05 cts. per lb.; how much did he make on the coffee ?

1 livre = 14 cts. 2¾ m. & 2646 livres = $377·62 cts 2 m.
2646 livres = $377·62† cts. cost in St. Domingo.
2646 × ·02 = 52·92 cost for freight.
2646 × ·05 = 132·30 cost for duties.

$552·84 cost of coffee at Boston.
2646 lbs. × ·24 cts = $635·04 — 552·84 = $82·20 cts Ans.

A TABLE,

For paying and receiving the gold coins of Spain and France, agreeable to an act of Congress, by which act said coins shall be valued at 100 cents for every $27\frac{2}{5}$ grs.

grains.	[illegible]	[illegible]s. cents.	137ths of a cent.	dwt.	Dol.	dimes. cents.	137ths of a cent.	ounces.	Dol.	dimes. cents.	137ths of a cent.	ounces.	Dol.	dimes. cents.	137ths of a cent.
1=	0	03	89	4=	3	50	50	11=	192	70	10	39=	683	21	23
2=	0	07	41	5=	4	37	131	12=	210	21	123	40=	700	72	136
3=	0	10	130	6=	5	25	75	13=	227	73	99	41=	718	24	112
4=	0	14	82	7=	6	13	19	14=	245	25	75	42=	735	76	88
5=	0	18	34	8=	7	0	100	15=	262	77	51	43=	753	28	64
6=	0	21	123	9=	7	88	44	16=	280	29	27	44=	770	80	40
7=	0	25	75	10=	8	75	125	17=	297	81	3	45=	788	32	16
8=	0	29	27	11=	9	63	69	18=	315	32	116	46=	805	83	129
9=	0	32	116	12=	10	51	13	19=	332	84	92	47=	823	35	105
10=	0	36	68	13=	11	38	94	20=	350	36	68	48=	840	87	81
11=	0	40	20	14=	12	26	38	21=	367	88	44	49=	858	39	57
12=	0	43	109	15=	13	13	119	22=	385	40	20	50=	875	91	33
13=	0	47	61	16=	14	01	63	23=	402	91	131	51=	893	43	9
14=	0	51	13	17=	14	89	7	24=	420	43	109	52=	910	94	122
15=	0	54	102	18=	15	76	88	25=	437	95	85	53=	928	46	98
16=	0	58	54	19=	16	60	32	26=	455	47	61	54=	945	98	74
17=	0	62	6	20=	17	51	113	27=	472	99	37	55=	963	50	50
18=	0	65	95	*Ounces.*				28=	490	51	13	56=	981	2	26
19=	0	69	47	1=	17	51	113	29=	508	2	126	57=	999	54	2
20=	0	72	136	2=	35	3	89	30=	525	54	102	58=	1016	05	115
21=	0	76	88	3=	52	55	65	31=	543	6	18	59=	1033	57	91
22=	0	80	40	4=	70	7	41	32=	560	58	54	60=	1051	09	67
23=	0	83	129	5=	87	59	17	33=	578	10	30	61=	[illegible]068	61	43
24=	0	87	81	6=	105	10	130	34=	595	62	6	62=	1086	13	19
Dwt.				7=	122	62	106	35=	613	13	119	63	1103	64	132
1=	0	87	81	8=	140	14	82	36=	630	65	95	64=	1221	16	118
2=	1	75	25	9=	157	66	58	37=	648	17	71	65=	1138	68	94
3=	2	62	106	10=	175	18	34	38=	665	69	47	66=	1156	20	70

FORM OF A PROMMISSORY NOTE.

Exeter, September 21, 1812.

For value received I promise to pay to Mr. Thomas Thinkwell, or order, the sum of one thousand and twenty one dollars ; in one year from the above date, with interest till paid ; witness my hand.

$1021·00 *SAMUEL NEEDY.*

ANOTHER FORM OF A NOTE.

I, Samuel Swanzey, of Danvil, in Vermont State, promise to pay to Nicholas Thirsty of Exeter, N. H. or order, the sum of five hundred dollars, and seventy cents, in six months, with interest, it being for value received at Exeter, thistwenty first day of September, A. D. 1812 ; *witness my hand.*

$500·70 *SAMUEL SWAN*[illegible]*Y.*

FORM OF A NOTE BY TWO, OR MORE PERSONS JOINTLY AND SEVERALLY.

We the subscribers, jointly and severally, promise to pay to Samuel Orr, or his order, the sum of one hundred and sixty dollars and ninety cents, in one year from the date hereof, with the interest, it being for value received at Exeter this 21st day of September, A. D. 1812 ; *witness our hands.*

DANIEL DILIGENT.
$160·90 *SAMUEL NEGLIGENT.*
RICHARD FAITHFUL.

FORM OF AN ORDER.

Exeter, September 21, 1812.

Mr. Thomas Willingtopay, Sir, please to pay to Mr. Samuel Needy, or order fifty dollars, it being for value received, and the same shall be allowed by me. *NATHAN TRUSTY.*

RECEIPT IN FULL OF ALL DEMANDS.

Exeter, September 21, 1812.

Then received of Mr. David Paywell twenty one dollars, in full of all dues, debts and demands, to this date ; I say received per me. *TIMOTHY THINKWELL.*

RECEIPT FOR MONEY RECEIVED ON ACCOUNT.

Exeter, September 21, 1812.

Then received of Lyman Chute sixty one dollars, and seventy cents, on account ; I say received per me.

EBENEZER ACCOUNTANT.

Dr. Mr Richard Montgomery, of Portsmouth, in account current with James Nye, of Exeter.

A. D. 1811.				*A. D.* 1811.			
June	20	*To 6 barrels flour at $10 per bar.*	$60·00	*Sept.*	19	*By cash - - - - - - - - - -*	$61·20
July	11	*To one cwt. sugar at $15 per cwt.*	15·00	*Nov.*	11	*By an order on Mr A. B. - - -*	15·16
do.	19	*To cash paid James Dirgan per order*	10·00	*Dec.*	21	*By cash by the hand of James Orr*	29·76
Aug.	20	*To sundries as per bill - - - -*	26·93	*do.*	24	*By repairing my chaise - - - -*	21·70
do.	29	*To goods delivered to A. B. per order*	29·25	*A. D.* 1812.			
Sept.	6	*To 1 bar. rum 32½ gal. at $1·20 cts.*	39·00	*Jan.*	15	*By cash by the hand of James Orr*	101·63
Oct.	10	*To 42 gal. molasses at 56 cts. - -*	23·52				
Dec.	21	*To 2½ cwt. of iron at $5·50 cts. -*	13·75				
do.	29	*To 60 lbs. sugar at 10 cts - - - -*	6·00				
			$229·45				$229·45

Exeter, 15th January, A. D. 1812.

Errors excepted.

JAMES NYE.

When a person is furnished with his account current, the various charges should be specified, and the dates when the articles were delivered; when the articles are numerous, some Accountant's make but one charge in the account current, referring to an annexed account of the several articles included.

Table of Contents.

* * *

Page.
Addition and Subtraction Table - - - - 7
Simple Addition - - - - - - - - - - - 8
Simple Subtraction - - - - - - - - - 9
Simple Multiplication - - - - - - - - 10
Simple Division - - - - - - - - - - 14
Short Division - - - - - - - - - - 17
Compound Addition - - - - - - - - - 18
Compound Subtraction - - - - - - - - 28
Decimal Fractions - - - - - - - - - 36
Addition of Decimals - - - - - - - - 37
Subtraction of Decimals - - - - - - - 38
Multiplication of Decimals - - - - - - 39
Division of Decimals - - - - - - - - 40
Reduction of Decimals - - - - - - - - 42
Compound Multiplication - - - - - - - 46
Bills of Parcels - - - - - - - - - - 47
Rules concerning boards, plank, &c. - - - - - 50
Decimal Tables of weights and measures - - - 52
Reduction Descending - - - - - - - - 56
Reduction Ascending - - - - - - - - 57
Compound Division - - - - - - - - - 58
Average Judgment - - - - - - - - - 62
Single Rule of Three Direct - - - - - - 63
Method of making Taxes - - - - - - - 69
Inverse Proportion - - - - - - - - - 77
Double Rule of Three - - - - - - - - 79
Vulgar Fractions - - - - - - - - - - 81
Addition of Vulgar Fractions - - - - - 88
Subtraction of Vulgar Fractions - - - - - 92

Page.
Multiplication of Vulgar Fractions - - - - - 96
Division of Vulgar Fractions - - - - - - - *ib.*
Rule of Three in Vulgar Fractions - - - - - 97
Simple Interest - - - - - - - - - - 98
When endorsements are made on notes; a new method 103
Compound Interest - - - - - - - - - 107
Single Fellowship - - - - - - - - - 110
Double Fellowship - - - - - - - - - - 111
Practice in American Money - - - - - - 113
Tare and Tret - - - - - - - - - - - 115
Discount - - - - - - - - - - - - 118
Equation of payments - - - - - - - - 120
Alligation Medial - - - - - - - - - 121
Alligation Alternate - - - - - - - - - *ib.*
Square Root extracted - - - - - - - - 125
Square Root applied - - - - - - - - - 128
Cube Root extracted - - - - - - - - - 132
Cube Root applied - - - - - - - - - - 136

PART II.

Mensuration of Planes and Solids.

Page
Duodecimals, or Cross Multiplication - - - - - - 138
Superficial measure - - - - - - - - - - - - 143
Case 1; to measure a parallelogram - - - - - - 144
Case 2; to measure a plane whose ends are unequal 146
Case 3; to measure triangles - - - - - - - - 147
Case 4; to make a board rule - - - - - - - - 149
Case 5; to measure boards with the board rule - - 150
Case 6; to measure boards with Gunter's sliding rule 151
Case 7; to measure boards with Gunter's scale - *ib.*
Case 8; to measure joist, plank, &c. - - - - - 152
Case 9; to measure an irregular plane figure - - *ib.*
Case 10; to measure a circle - - - - - - - - 153
Case 11; to measure a sector of a circle - - - - 156
Case 12; to measure a segment of a circle - - 157
Case 13; to find the area of a polygon - - - - 158
Case 14; to describe and find the area of an ellipsis 159
Case 15; to find the area of a globe, or sphere - - 161

MENSURATION OF SOLIDS.

Page.
Case 1; to find the solidity of a prism - - - - 161
Case 2; to find the solidity of any figure equal in width and thickness - - - - - - - - - - - - 162
Case 3; to find the solidity of a figure equal in thickness, but unequal in width - - - - - - 163
Case 4; to find the solidity of a cylinder - - - 163
Case 5; to find the solidity of cones and pyramids - 164
Case 6; to find the solidity of the frustum of a cone, or pyramid, &c. - - - - - - - - - - - - 165
Case 7; to find the solidity of a segment of a cone - 167
Case 8; to find the solidity of a wedge - - - - 167
Case 9; to find the solidity of a wedge when the edge is narrower than at the other end - - - - 168
Case 10; to find the solidity of a globe or sphere - 169
Case 11; to find the solidity of a segment of a globe or sphere - - - - - - - - - - - - 170
Case 12; to find the solidity of the middle zone of a globe or sphere - - - - - - - - - - - 171
Case 13; to find the solidity of a spheroid - - 172
Case 14; to find the solidty of an elliptic spindle - 173
Case 15; to find the solidity of the middle frustum of an elliptic spindle - - - - - - - - - - 174
Case 16; timber measure; the common method - 175
Case 17; a new method of finding the solidity of square timber, in a round stick - - - - - - - 177
Case 18; to find the solidity of a round stick of timber, including the four slabs or segments - - - - 181
Case 19; to find the solidity of hewn timber in a round stick, when it is tapering from end to end - - ib.
Case 20; to find the solidity of a round stick of timber that is tapering from end to end including the four segments - - - - - - - - - - - - 182
Case 21; to find the solidity of a hewn stick of timber that has all its sides parallel - - - - - - - 184
Case 22; to find the solidity of a tapering hewn stick of timber, whose sides are not parallel - - - 185
Case 23; to find the solidity of timber by Gunter's slider - - - - - - - - - - - - 187
Case 24; wood and bark measure - - - - - ib.

Page.
Case 25; having the base, or bottom of a pile of wood or bark given, to know how high to build, that the pile may contain any quantity required - - - 188
Case 26; to find the solidity of a parallelopipedon - 189
Case 27; to find the solidity of any cube - - - 190
Guaging - - - - - - - - - - - - - - - - ib.
Water levelling - - - - - - - - - - - - - 200
Reduction of coins - - - - - - - - - - - - 202
Monies of the world; intrinsic value of in dol. cts. &c. 210
Table for paying and receiving Gold Coins of Spain and France - - - - - - - - - 225
Forms of notes, receipts, &c. - - - - - 226
Form of an account current - - - - - 227

ERRATUM.

Page 77, question 1st, the third term should be 8+4 instead of 12+4; and the answer should be 8 instead of 6 days.

The AUTHOR, *by a careful examination of the work after it was printed, has discovered the following errors, and has thought it advisable to notice them.*

Page 24, Q. 1. for 21 gal. read 27 gal. Page 24, Q. 1. P. Q. for 5 gal. read 14 gal. Page 26, Dry M. Q. 1. for 0 qt. read 1 qt. Page 27, 1. P. Q. for 203 yd. read 193 yd. Page 27, Cloth M. Q. 3. for 905 E. Fl. read 906 E. Fl. Page 33, S. M. Q. 3. for 34 ft. read 39 ft. Page 40, 4. line, for Propuct, read Quotient. Page 46, Q. 8. for 1700† in. read 1721† in. Page 47, Bills of P. for $74, read $72. Page 48, Case 2. Q. 1. for $19, read $29. Page 51, Q. 2. from top, for ·55 cts. 1 m. read ·57 cts. 1 m. Pages 57 and 58, Q. 9. 1. lines, for minutes, read hours. Page 59, Q. 3. at top, for $180·80, read $181·80. Page 90, Q. 2. for $\frac{1404}{560}$, read $\frac{702}{280}$, &c.—Page 91, Q. 2. for 14272, read 14277, &c. Page 118, Q. 2. for 1991$\frac{334}{1456}$, read 2003†. Page 118, Case 5. Q. 1. for as 112 to 14, read as 104 to 4. Page 120, Q. 2. at top, for $\frac{18}{108}$, read $\frac{86}{108}$. Page 121, Q. 2. ans. for ·70 cts. 6 m. read $7·06. Page 129, Q. 3. for 18 acr's 16$\frac{10800}{27225}$ rds. read 17 acr's 150$\frac{3850}{27225}$ rds. Page 149, Q. 3. ans. for 500 ft. read 250 ft. Page 157, Q. 1. for 1236 ft. in Circle, read 1256, and for 154·5 in ans. read 157. Page 166, Q. 1. ans. for 467·65†, read 468·06†. Page 169, Q. 1. Case 10. for 768486·9422, read 755500·8692. Page 182, Q. 3, ans. for 35$\frac{8}{13}$, read 34$\frac{4}{144}$. Page 190, Q. 2. ans. for 6' read 11'. Page 205, Q. 3. ans. for 524 dolls. read 549 dolls. Page 205, 4. for 1049 dolls. read 1048 dolls.

Charles Collins is My
name and Corinth
Is my Station and new
englan is my dwelling
place and crist is my
Salvation when I am
ded and in my grave
and all my Bones
are roten I leave this
Book that you may
look and see I not
Forgotin